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The Early Method of Counting Gave Us Our Word **TALLY**

Tally goes back to the time when a count of things was made by cutting notches in a stick of wood. The word is derived from the French *tailler* "to cut" and *taille* "a cutting," "a tally." It was customary, in earlier times, for traders to have two sticks and to mark with a notch on each the number or quantity of goods delivered, the seller keeping one stick and the purchaser the other. When such records came to be kept on paper, the same word was used, and it is now generally applied to various kinds of counts and scores.

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A deliberate division is one based upon a weighing of the facts and arguments involved—and that is the literal meaning of the word *deliberate*. It is derived from Latin *deliberatus*, formed from the verb *deliberare* which is a combination of *de*, a prefix meaning "from," and *berere* "to weigh." *Ubiare* comes from *haec* "a balance or pair of scales."



INTOXICATE

From "Pulsated Arrows"

The Greek word *τανα* means "arrow." From this we derive the Greek *τανα* and Latin *tinctum*, a column in which arrows were dipped. This was the source of the Latin *tinctum*, "a drug or potion" and of English *intoxicant*.



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In This Issue—Hundreds of Articles and Pictures Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

CONSTRUCTION KIT FOR MAKING A BATTLESHIP MODEL AT LOW COST

TO ENCOURAGE you to build our new ship model, the battleship "Texas," described on pages 67, 68, and 69 of this issue, the Popular Science Homecraft Guild is offering a complete construction kit of materials for \$6.95, shipped postpaid to any address east of the Mississippi River. To points west of the Mississippi it is necessary to charge 50 cents extra because of the high shipping costs.

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For radio entertainment that is different listen in to the Corn Cob Pipe Club of Virginia, broadcast over the NBC coast-to-coast Red network every Wednesday evening at 10 o'clock, Eastern Standard Time.

Why BUSINESS MEN are beginning to Smile

By LEON MEADOW, *Financial Editor*

A FEW days before the November Financial Article was scheduled for the press, we received a letter asking for a summary of present financial and business conditions. The writer also wanted to know exactly what had been accomplished by the various relief measures organized to combat the depression, and what, in our opinion, could be expected for the near future.

It would take a very long letter to answer all that, and, furthermore, these are questions that are on everyone's lips today. So we changed our plans for this month's column and took the liberty of publishing our reply in the form of the following article.

* * *

IN THE last few months a great change has taken place in our country's economic and financial affairs. Almost three years of declining business and decreasing security values had made it look as if all traces of previous prosperity had been completely wiped out. Due to the strong momentum of this deflation and due also to financial reversals abroad, all the heroic measures taken to stem the tide seemed practically worthless.

At times it looked as if the United States were headed for a complete breakdown, utter bankruptcy. But it isn't necessary to give the story in complete detail. We all read about, talked about, and knew about the situation as it stood at the beginning of the summer in 1932. And we should know by now that such conditions easily lead to despair and create a state of mind which is in itself highly destructive. Bear this in mind as you read our explanation of the reversal in trend and sentiment which came about in July and August.

FINANCIAL and economic life today is so complex that any large movement (either up or down) is invariably the result of a variety of causes. Yet, in looking for the principle factors which brought about so sharp an improvement in sentiment in these last few months, it would probably be correct to give credit to two sets of circumstances—a natural one and an artificial one. Together, they seem to have mastered the situation. The natural factor was the simple fact that there is a limit to any downward movement—just as we learned in the fall of 1929 that there can be a decided limit to an upward trend. Roll a rock off a high mountain top and it may seem irresistible as it gathers

speed and rides over everything in its path. And yet, that rock can't go on forever. Somewhere, sometime it will stop or be stopped.

This, economically speaking, was the situation we faced as the first half of the current year neared its end. Production and consumption, transportation and employment, market values of commodities, stocks and bonds—all had dropped to unheard of levels during a period that covered almost three full years. Steel mills were running at one-tenth of plant capacity, rail transportation was back to pre-war volume. Commodities were selling for far below their production costs, stock averages represented 10% of their 1929 highs and the bond market was in a totally demoralized condition.

But this, like the rock, couldn't go on forever. With steel plants operating at only 10 to 14% of capacity, it was unreasonable to expect a further decline unless the country were returning to the Stone Age! It was equally unreasonable to assume that agricultural, mining and other products should continue to sell so far below cost. And, in the stock and bond markets, values were simply being given away, as if there were never a chance of any improvement.

HOWEVER—and here we come to the artificial factor—when things actually do have the aspect of threatening disaster, the rescue is nearby. In this case, the extreme seriousness of the situation moved our Government to more efforts to support the weakening structure of our banking and credit systems. Even more heroic steps were taken to instill life into our commodity and security markets. Our governmental system, by the very nature of its structure, is slow to move, even during times of economic depression. But once it becomes clear that real danger is present, a sense of patriotism, above party interests, has always prevailed. This is what can and, in this case, did ultimately lead to swift and effective measures. Credit must be given to the co-operation of our two leading political parties. They made possible in the "nick" of time the passage of a number of laws which were extremely helpful in avoiding pitfalls that awaited our fight against economic and financial recession. Private business—in particular, our banks—added strength to the movement by organizing support for the security markets.

The Glass-Steagall Law (P. S. M., June '32, p. 4) was one of the first constructive measures aimed at, and successful in re-

ducing the number of bank failures and in protecting the gold standard. Then came the Reconstruction Finance Corporation, formed to take over and broaden out the operations of the old National Credit Corporation. The latter had a capital of half a billion dollars, subscribed for by private banks. For the new organization, the Government appropriated half a billion dollars also, and besides gave it the power to issue debentures up to \$1,500,000,000—guaranteed as to principal and interest by the Government. In this way an enormous amount of capital was available for making loans to banks, insurance companies, building and loan associations, mortgage and finance corporations, Federal Land Banks, agricultural credit corporations, etc. An amount of \$50,000,000 was immediately turned over to the Department of Agriculture for the purpose of making loans to farmers.

AMONG the last acts passed by Congress before it adjourned was the so-called Relief Bill, permitting the Reconstruction Finance Corporation to raise \$1,800,000,000 by the sale of debentures. \$1,500,000,000 of this was to be used for making loans to states and cities for productive works, while the other \$300,000,000 was to be set aside for unemployment relief work.

Other measures included the empowering of the Federal Banks to lend capital to corporations and individuals directly under certain conditions and the appropriation of \$322,000,000 to be spent by the Government for public construction work. Recently, the new Home Loan Bank Bill was put into operation by the formation of 12 Home Loan Banks, principally intended to relieve the mortgage situation, but also in a position to render financial aid in the construction of new homes and apartment houses. A sixty day moratorium, postponing mortgage debt foreclosures, was ordered to give corporations and individuals a respite should distress hit them before the aid offered by these new Home Loan Banks became available. And last—but not least—there are the steps taken toward balancing the Federal Budget. This removed the uncertainty which for a long time had threatened to upset our financial structure almost beyond repair.

Among private measures, the \$100,000,000 "bond pool" organised by leading banks must be mentioned. Also, there is the formation of the Commodities Finance Corporation, designed to remove the threat of huge commodity surpluses overhanging the market.

These gigantic artificial stimulants were administered at practically the same moment at which business and security values touched bottom. They suddenly and unexpectedly brought about the realization that a serious collapse had been averted. Public sentiment changed from despair to hope. At first moving slowly, this improvement gained momentum and surprised the world by its increasing strength. The first sign was an improvement in the market price for hogs—and it was soon followed by an improvement affecting many other commodities.

The banking situation was also greatly relieved, failures became rare. Confidence in country banks (*Continued on page 81*)

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Suppose you want to retire at 60 on \$250 a month. You make sure of: 1. An income of \$250 a month for yourself, beginning at age 60 and lasting the rest of your life. 2. A life income for your wife if you die before age 60. 3. A monthly income for yourself if, before age 55, serious illness or accident stops your earning power for good.

A Retirement Income may be paid for in monthly installments. It goes into effect the minute you pay your first installment. Even if you should become totally disabled you would not need to worry, because your in-

stallments would be paid by us. And you would be paid a disability income besides.

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Other benefits which may be included are: Money to leave your home clear of debt, Money to send your son to college, Money for emergencies, Money for special needs.

An illustrated 84-page free booklet fully explains this new Retirement Income Plan. No cost. No obligation. Send for your copy today.



You can enjoy six months' vacation twice a year with a Phoenix Mutual Retirement Income.



The Phoenix Mutual Plan enables you to say good-bye to money worries for good.



No wonder people with Retirement Income live longer. No work. No worries.



PHOENIX MUTUAL LIFE INSURANCE CO., 318 Elm St., Hartford, Conn.
*Send me by mail, without obligation, your new full descriptive
THE PHOENIX MUTUAL RETIREMENT INCOME PLAN.*

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Business Address _____
Home Address _____

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Guest Cruises

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Indies**
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GREAT WHITE FLEET

11 days *\$115

To JAMAICA. Stay at our renowned Myrtle Bank Hotel, Kingston, room and meals and comprehensive auto trip included. Outdoor sports. Stay an extra week for \$35. American Plan.

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Pier 3, North River or
332 Fifth Ave., New York

WHY BUSINESS MEN ARE BEGINNING TO SMILE

(Continued from page 7)

was restored, for now, provided they were actually solvent, they could receive aid from the Government. Many receiverships of large railroads and utility companies were avoided. The rise in commodity prices rekindled hope among farmers, manufacturers, and retailers. All these factors reflected themselves quite naturally in the security markets, causing stock averages to rise at an almost unequalled pace, and regaining for bonds an average of 40% of the level to which they had fallen.

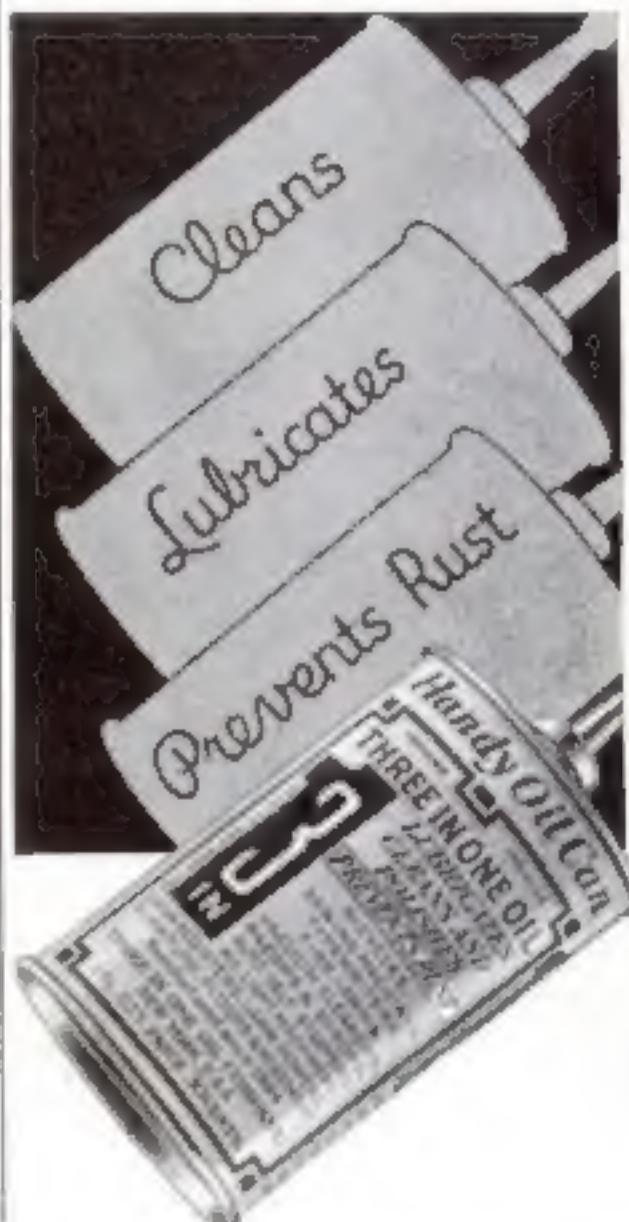
Cattle prices rose from 6.15¢ per pound in May to 8.20¢ in August; hogs from 3.45¢ to 4.30¢; cotton from 5.25¢ to 7.34¢; Sugar from 2.38¢ to 3.15¢ in this same period. During the last part of August wool, silk, copper, rubber, cocoa and many other commodities moved upward. The market value of representative industrial stocks almost doubled, and that of railroad stocks more than tripled. The rise in bond averages has been given above.

And now, to answer the second question of the letter that prompted this article, we must first ask and answer another question. What is the practical value of all these signs, indications, artificial reliefs and organizations? Toward what do they point?

FOR one thing, its value lies in the return of confidence and hope in the public mind; the realization that in our mood of despair and pessimism we had lost all sense of intrinsic value; the firm conviction that, after all, our country is not lost, but can look ahead to better times. The practical value lies, therefore, in a correction of mistaken opinions, in the restoration of a common sense view of the situation. Partly, it is also an expression of the expectation that we have all awaited—namely, that we have now actually begun an upward trend. A rise in commodity prices and security quotations, such as recently took place, has often been the signal for the end of previous depressions. For this reason the fact that business in general has not improved as yet should not necessarily be taken as evidence that the current improvement in markets is unfounded. But a well meant warning to avoid exaggeration before definite proof is there, is not out of place. By now, all of us should have learned the dangers of overdiscounting and exaggeration, and it will certainly be better to go slowly and surely than to rush and be sorry. Nothing would be more pitiful than to have this welcome improvement abused to such an extent by false enthusiasm that a serious reaction would be inevitable. All the good work done at so great a cost and effort would only be destroyed, and then this country would certainly face an even harder task in rebuilding from such a collapse.

What must not be forgotten or allowed to slip the mind for a minute is the fact that recovery from three years of depression is bound to be slow. It cannot be accomplished over (Continued on page 9)

TRIPLE PROTECTION AGAINST UNNECESSARY SHOP EXPENSE



Here's an oil that saves you many a repair and replacement bill by giving *triple protection* to all your shop equipment.

Three-in-One is especially blended from three good oils, so it does three good jobs. As it lubricates it cleans gum-forming dirt from working parts, then prevents rust. No ordinary oil can provide this protection so effectively. Handy cans and bottles; at good stores everywhere.

Three-in-One Oil Co., New York

3-IN-ONE OIL

WHY BUSINESS MEN ARE BEGINNING TO SMILE

(Continued from page 8)

night. The rebuilding of national purchasing power will of course be gradual, business volume, feeling its way in the dark, can only increase little by little. Many adjustments are still to be made, and they will have to be made in an orderly fashion. Very likely, unemployment will be with us for some time, although it is to be hoped that a steady reduction of it will take place.

In the light of all this, it is not very wise to anticipate a rapid revival. On the other hand, even a conservative attitude warrants a much more hopeful outlook than that which seemed ahead of us three months ago. This nation can breathe again with a well earned sigh of relief. We are still on firm ground, and ahead of us is the hard, but not impossible task of rebuilding for normal, good times on a sounder and more lasting basis than the flimsy speculative structure that the 1929 prosperity proved to be.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worthwhile investment as well as a form of protection. Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with Full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate Plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

WANTED

*men who would like to
retire at 65*

ON \$200 A MONTH

ARE YOU UNDER 65 AND MALE?
If so, this advertisement is addressed to you. We assume, of course, that you are not engaged in any hazardous occupation and that your health is good.

THE PROVIDENT PROVIDOR

Under the terms of this simple investment plan you can arrange for a monthly retirement income that will be adequate for your needs. It may be \$200. It may be \$30, \$300, or more. But whatever the amount, you will be interested in this modern way of securing for yourself an income that is guaranteed as long as you live.

YOU'RE INSURED IN THE MEANTIME—Your family is also protected during the time that you are saving toward this retirement income. A Provident Providor designed to provide an income of \$200 a month would pay your family \$20,000 in cash in case of your prior death. If death should result from accidental cause, your family would be paid \$40,000, or double the face amount of the policy.

SHOULD YOU BECOME TOTALLY DISABLED—The company will arrange to pay all premium deposits

for you if you become totally disabled for a prolonged period of time before reaching age 60. Furthermore, you will be entitled to your share of annual dividends. Under certain conditions a monthly income will be paid during disability. Thus, practically every contingency has been thought of.

HOW MUCH DOES IT COST? Convenient annual premium deposits take care of everything. Just how large or how small these deposits are depends, of course, on your present age and the amount of retirement income you will choose.

But remember, the Provident Providor should not be thought of as an expense. It's a sound investment—and is backed by an old-line company with over a quarter billion dollars of assets.

Find out today just how small a premium is required to secure for you the income you want. A free booklet will be sent at your request. Just mail the coupon.

Provident Mutual

Life Insurance Company
of Philadelphia, Penna.
Founded 1863

PROVIDENT MUTUAL LIFE INSURANCE CO.
PHILADELPHIA, PA.

Please send free booklet and quote premium rates at my age for the Provident Providor, with the understanding that it places me under no obligation.

CUT AND MAIL THIS COUPON

My name _____

Home address _____

Business address _____

I am here _____

Awards valued at **\$75,000** ENROLL NOW!

Every boy in the United States and Canada, between the ages of 12 and 19 years, is eligible

Join the Fisher Body Craftsman's Guild! ... Associate yourself with live, ambitious boys throughout the United States and Canada.... Take part in a test of skill that gives you every chance to win recognition and earn substantial awards for work well done.

More than 2,000 awards have already been distributed among Guild members. All the contestants have gained invaluable experience—formed lasting friendships—learned much that will help them toward success through all their lives to come.

The Third Annual Guild Competition is now getting under way, and you can enter without paying a cent in fees or dues. Just follow the simple instructions on the opposite page.

Boys who took part in the 1931 or 1932 competition can also enter this one, but they must enroll again to be eligible to compete.

Where else have you ever seen or heard of such an opportunity? It's knocking on your door now for the third time. Why don't you do something about it?

These boys earned \$5,000 Scholarships this year



GORDON DRUMMOND (3)
340 Quincy St., N.W.
Washington, D.C.



FRANZ IBISCH (5)
Newcombe St.
Columbus, W.H.



FRED FRIEDRICH (1)
277 Lexington Ave.
Rochester, N.Y.

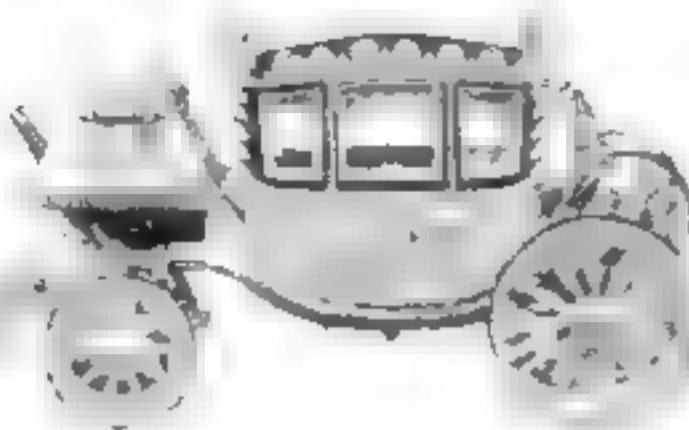


RAYMOND SMITH (1)
501 B Avenue
Lawton, Okla.

F I S H E R

B O D Y

Another big opportunity!



Four University Scholarships . . . 112 trips to Chicago's "Century of Progress" Exposition . . . 1120 other valuable awards

A complete college education in return for proof of outstanding skill! That's how four Guild boys are going to be rewarded.

A royal time at the Guild convention in Chicago, where that long-heralded "Century of Progress" Exposition will be in full swing! Such is the award awaiting 112 boys who earn first Senior and Junior honors.

And there are 1120 Gold Awards, 20 for each of the United States, and 20 for each Guild District in Canada. In all, Guild members will receive awards valued at \$75,000!

Conditions of the 1933 Guild competition are the same as those which governed the two previous competitions. The judges are men of highest standing in the knowledge of craftsmanship. At their head as Honorary President is Daniel Carter Beard, National Boy Scout Commissioner. Honorary President of the Canadian Section is John A. Stiles, Dominion Commissioner for Scouting.

Join the Guild. Enter the competition. It may be your big chance to get started on a successful career! Read the simple instructions below—fill out the coupon—and enroll today!

How to Enroll in the Guild

It's easy to become a Guild member. Just go to any dealer in General Motors cars (Cadillac-LaSalle-Buick, Oldsmobile-Pontiac, Chevrolet) and say you want to join. He will do the rest. Your Manual Training teacher also can take your application to the local Boy Scout Leader. Or you can simply fill out the coupon at the right and mail it to Guild Headquarters. Shortly after enrolling you will receive your membership card, an official Guild button and complete information about the Guild craftsmanship competition for 1933.

Fisher Body Craftsman's Guild Enrollment Coupon

(Please print plainly in all spaces below)

Boy's Name _____

Name of
your School _____

Enrolled before Yes No

Grade _____

Born _____ day of

Manual Training
Teacher _____

Address _____

Month _____ Year _____

Principal _____

City _____ State _____

Be sure to mail this coupon at once to the Fisher Body Craftsman's Guild, General Motors Building, Detroit, Mich.

CRAFTSMAN'S GUILD

Our Readers Say

Cheap Sunshine Requested for Oklahoma Winter

Now is the time for someone to write an article for your magazine showing how to rig up at home a unit that will enable us "sun starved" people to enjoy the Maria Sunshine Bulb next winter with no more expense than the cost of the bulb, scrap materials, and a little time. We poor folks can't afford even the least expensive "sunshine" unit and stand. But we want our sunshine. We are hungry for it! The cheapest complete outfit is around \$30. The bulb is only about \$3.75. Why should the unit (the voltage reducer, the transformer, or whatever it is) cost so much? I pretend to be broad-minded enough not to say that an article on the lamp unit should take the place of such-and-such an article, because nothing is so nearly perfect as to please all your readers. Now if this "I read I minded" letter gets into "Our Readers Say," I suppose your cartoonist will depict me running my large head with an ultra-violet lamp. If it gets in, I wish you would first have an English composition professor and an electrical expert rewrite it so I'll be protected from the mud that some readers are always ready to sling!—W. S., McAlester, Okla.

After All, Tools Are Needed To Build a Good Boat

I'M A fairly new reader, but already getting the fun spirit about your Workshop Department. Being a rank amateur when it comes to building things, I'd like to raise a little point in connection with your blueprint articles. When you tell us how to make a boat or canoe, for example, and give a list of materials needed, why don't you also tell us what tools are needed for the job? I'd like to have an idea how much I'll have to spend for tools I may not have for some particular project I'd like to make.—H.M., Carmel, N. Y.

Are You a Hero—and Why? Don't All Answer at Once

Here's one for some psychological shark suggested by your "Robot Hero and Fire Panic" article in the October issue. I've known a flock of heroes—I'm not one of them—and as far as I could see each was first cousin to a jelly fish: splendidly stupid and not a thrilling nerve in his body. They merely went into the hero business because they didn't know enough to keep out of it. I'm not referring to police officers and firemen, who are paid to be heroes, but to the common and garden variety—the amateur hero. Am I right? You bet your life and I am. For a pleasant companion and friend, give me a cheerful coward every time.—J.F., Dallas, Texas.



When the Moon Comes Over the Orange Belt, Calif.

I THINK G.D.W. of Lansing, Mich., is wrong in his explanation of "Full Moon and Frost." In the first place, dew does not fall. It condenses on the ground or on the foliage of plants. Therefore, the gravitational force of the moon would have no effect upon the dew "falling." As to the heat of the moonlight we receive, I would suggest that G.D.W. get a good book on astronomy, and find out the exact amount of heat the earth receives from the moon. Here, in the Orange Belt, of California, much orchard heating is done and any grower will tell R.L.R. Worden, Ill., that the moon has no effect upon frost. Frost and temperatures down to ten or twelve degrees below freezing are controlled by the amount of water vapor in the air, or the dew point. Clouds and gentle winds also help to control the effect of the frost, and a warm day preceding the frost will lessen the damage.—H.P.C., Tustin, Calif.

If You Don't Know This One You Can Ask Your Cat

I suspect that some, if not all, of the readers of this page know why cats always land on their feet. I have heard it attributed to everything from accident to divine intercession, and consequently I did some research work to determine the facts. I will tell you the result, and I should like to see what others think about it, if anything. A cat swings its tail around like a crank when falling. Its body, of course, is revolved in the opposite direction, for action equals reaction. If a cat is dropped back down, with the feet turned slightly off vertical, the tail will be swung in one direction. But if the feet are off vertical in the opposite direction, the tail will swing the other way around. Now what puzzles me is whether the cat will always swing in either the clockwise or counter-clockwise direction if the feet are perfectly vertical when dropped. We might then find that some cats are clockwise cats, and some are counter-clockwise cats. I haven't a sufficient number of cats at my disposal to justify me in making a generalization. Air ships might be stabilized in like manner.—D.A.B., Detroit, Mich.



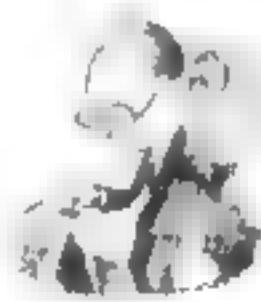
Splitting the Atom Holds Future of the World

Your articles on chemistry by Raymond B. Wailes hit the spot with many of us. It is my belief, though, that they are too elementary in character. I think something a little more technical would be appreciated by those of your readers who have taken high school chemistry and wish to continue study in that field of science. I am waiting for an article on the transmutation of elements and

the progress that has been made in that line of science in the last year. I believe that the future of the world is tied up in the "atom splitting activities" of modern science.—B.W., Vienna, S. D.

Here's a Mean Little Question for the Class in Evolution

MANY letters on "Our Readers Say" pages have been devoted to evolution. Pro and con. Here's an interesting fact these evolution bounds might ponder: The "gall fly," a little wasp that makes swellings on oak leaves, dates back to the time when three-toed horses still ranged the western part of the United States, according to Arnold D. Hoffman, University of Chicago research worker. Between two layers of shale, Hoffman found the impression of a prehistoric oak leaf with swellings closely resembling those on modern leaves. The wasps lay their eggs in the tissues of the leaves to insure abundant food for their young grubs. Where does this fit in with your evolution?—J.E.M., Yonkers, N. Y.



Little Balls, Big Balls All Keep Rolling Along

THE problem in a recent issue of POPULAR SCIENCE MONTHLY submitted by P.C., concerning the two bowling balls, can be answered by saying that both the largest and the smallest balls will require the same time to make the trip. The time that it will take either ball to reach the goal depends only on the starting or initial velocity and the acceleration given to it. In each case the initial velocity is zero because they both start from rest. The acceleration of each is due to gravity and is therefore the same. Thus the time of each ball is the same. It will be seen therefore that the size of the balls does not affect the time of their arrival at the destination.—R.J.B., Milwaukee, Wis.

Here's a Hiccup Remedy That Will Kill or Cure

WHAT the situation is down in your part of the world, I wouldn't know, but out here where men are men, there is an epidemic of hiccoughs. Make your own guess as to the cause. In a stubborn case, a good home remedy is the following: The sufferer holds an ordinary paper bag so that its open end covers his nose and mouth, excluding all outside air, and breathes in and out of it. This results in an accumulation of carbon dioxide gas in the bag. Breathing such a mixture has often



husted severe cases of hiccoughs. No harm is done as long as the treatment is stopped before the patient faints or dies or asks for another quick one.—E.L.R., Prescott, Ariz.

Maybe This Reader Has No Real Love for Dogs

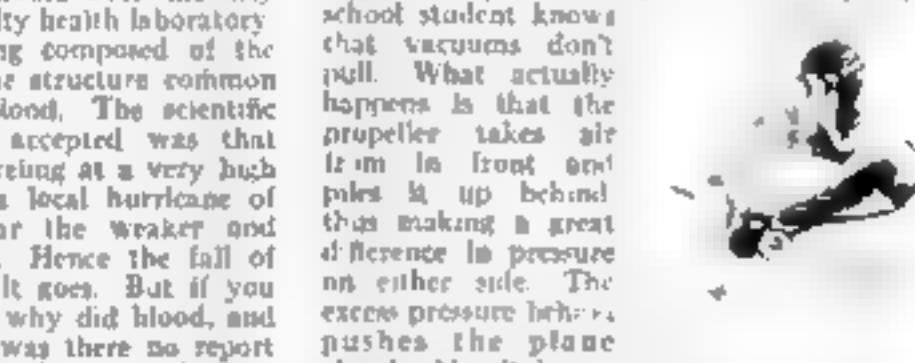
This dog business is rather getting on my nerves and I thought I'd just mention the fact to you. Civilized, city dwelling people have as much need of a dog as a high powered auto has for a horse. I see that over in Hungary compulsory vaccination of dogs is being tried out in an effort to stamp out hydrophobia. Once a year, all dogs, more than three months old, are to be given injections of anti-rabies serum. The cost of the injections will be borne by the state. Wouldn't it be a better idea to vaccinate the people against any desire to have the worthless beasts around? Noise, dirt, and fleas—that's a dog. Plus a weak minded sentiment, prehistoric in origin and atavistic in survival.—R.G., New York.

Blood Fell Like Rain But—Where Were the Feathers?

I've done a great deal of reading on the subject of weird, natural phenomena such as the fall of fish from the sky, reported in your article "It Does Rain Fish" in a recent issue of *POPULAR SCIENCE MONTHLY*, and I'm not satisfied with the so-called scientific explanations given for these occurrences. Here's another one for you. Some time ago, in the sixteenth century, a red liquid fell for several hours over the city of Rome. Taken to the city health laboratory it was analyzed as being composed of the same type of corpuscular structure common to human or animal blood. The scientific explanation given and accepted was that some flock of birds, traveling at a very high altitude, had run into a local hurricane of enough strength to tear the weaker and younger birds to pieces. Hence the fall of blood. Fine—as far as it goes. But if you accept that explanation, why did blood, and only blood, fall? Why was there no report of feathers, of bones, of flesh also falling? How would you explain it? Or does anyone think it likely this blood-like rain came from warring factions engaged on Mars or Venus?—A.C., Lowell, Mass.

Leaning Ladders Give You the Width of This Street

This is my first time in print and I am provoked into it now by G.N.P., of Meriden, Conn., who has asked for a mathematical chestnut. Here it is. Two ladders are leaning across a street. The street runs north and south. One ladder leans from the east side at the juncture of the building and side walk, and reaches over to the building on the other side. This ladder is forty feet long. The other ladder is thirty feet long and starts on the west side of the street at the juncture of the building and side walk and reaches over to the other side. At the point where the two ladders intersect it is ten feet to the pavement. The buildings are perpendicular. How far is it from one building to the other? You have the best magazine of its kind on the market.—P.E.F., Huntington, Ind.



Brother's Age Is Anything from Three to Eighteen

L.D.L., Pottsville, Pa., wants to know how old the boy, whom we will name John, is? We will name his brother, Bill. Now there is no solution to this problem. John could be the youngest and he could be three years old; six years old, nine years old, twelve, fifteen, or even eighteen years old. He could be three, nine years before Bill was one, now ten, or he could be six, nine years before Bill was two, now eleven. So, Mr. L.D.L., I am not going to tell you how old John is.—F.C.C.C., Flint, Texas.

Our Baby Planet Nothing to Get Haughty About

You mention, in a recent issue, of a new baby planet reminds me of one I have seen twice with the naked eye right here in Perth Amboy, N. J. I saw it first in November, 1939. Three years later I again saw it in October. Being astronomically inclined, I often look at the moon, looking my astonishment at seeing what I thought was a toy balloon passing across the moon. However, I soon saw it could not be a balloon as it took about three minutes to cross the moon. Possibly this little planet has been known for a long time, but anyway I thought it worth mentioning.—G.R.C., Perth Amboy, N. J.

Airplanes Keep on Flying But They Don't Tell How

WE certainly are appropriate initials for the bird in Harrisburg, Pa., whose letter appears in a recent issue of *POPULAR SCIENCE MONTHLY*. He is all wet. He claims an airplane gets its thrust from a partial vacuum in front of the propeller which is supposed to pull the plane through the air. Any high school student knows that vacuums don't pull. What actually happens is that the propeller takes air from in front and piles it up behind thus making a great difference in pressure on either side. The excess pressure behind pushes the plane ahead. Also it is my pet theory that the inertia of the air has something to do with it. From a complete standstill, the air is suddenly accelerated backward by the propeller. Thus the propeller is shoved ahead not only by the difference in pressure but also by inertia. As for the sailboat that's all boozey, too. The wind merely piles up behind the sail, raising the pressure and forcing the boat ahead.—M.C.W. Jr., Cortland, N. Y.

Where Popular Science Leads, The Others Follow Along

I BECAME acquainted with *POPULAR SCIENCE MONTHLY* about twelve years ago and have been a regular reader ever since. I shall continue to be one, too, for the pages of your magazine put me at least one jump ahead of everybody I know in knowledge of what is going on in the world. It has always been a source of wonder to me how you find so many interesting, new things to describe month after month and how you manage to get them first. Take just a few outstanding developments. *POPULAR SCIENCE* had a comprehensive and flourishing radio department long before radio broadcasting caught on with the public. Your readers knew all about the mechanics of talking pictures before a single talkie had been shown in a commercial theater. Readers of *POPULAR SCIENCE* did not need to wait for the epochal Landbergh

fight to make them air conscious. Your magazine had kept them in pace with aviation progress for years before that. When I saw the first newspaper article about the seadrome it was old stuff to me because its inventor had told *POPULAR SCIENCE* all about it a couple of years earlier. You printed articles on balloon tires, four-wheel breakers, and other automobile improvements before anybody but the automotive engineers had them on their cars. You have been ahead of the parade with everything from the Einstein Theory and cosmic rays to stratosphere aviation, television, and ship models. Keep it up, *POPULAR SCIENCE*, and more power to your sharp eyes!—A.O.R., Dubuque, Iowa.

Of Course, the Cows Might Give You the Answer

Can any of your bright and shining readers explain this one. A professor at Ohio State University, finds that a green grass diet for cows produces richer milk than one of dry fodder. His experiments, he says, were conducted over a period of several years. He compared the milk given by cows grazing in the open fields and those fed on fodder and the vitamin content of the latter was found far inferior. I assume the professor is right, but why? What is there in the green grass that isn't in the cured fodder? I'm a dairyman, and I'd like a simple answer to a hard question.

J.B.H., Bedford, N. Y.

Massachusetts Now Claims America's Crookedest River

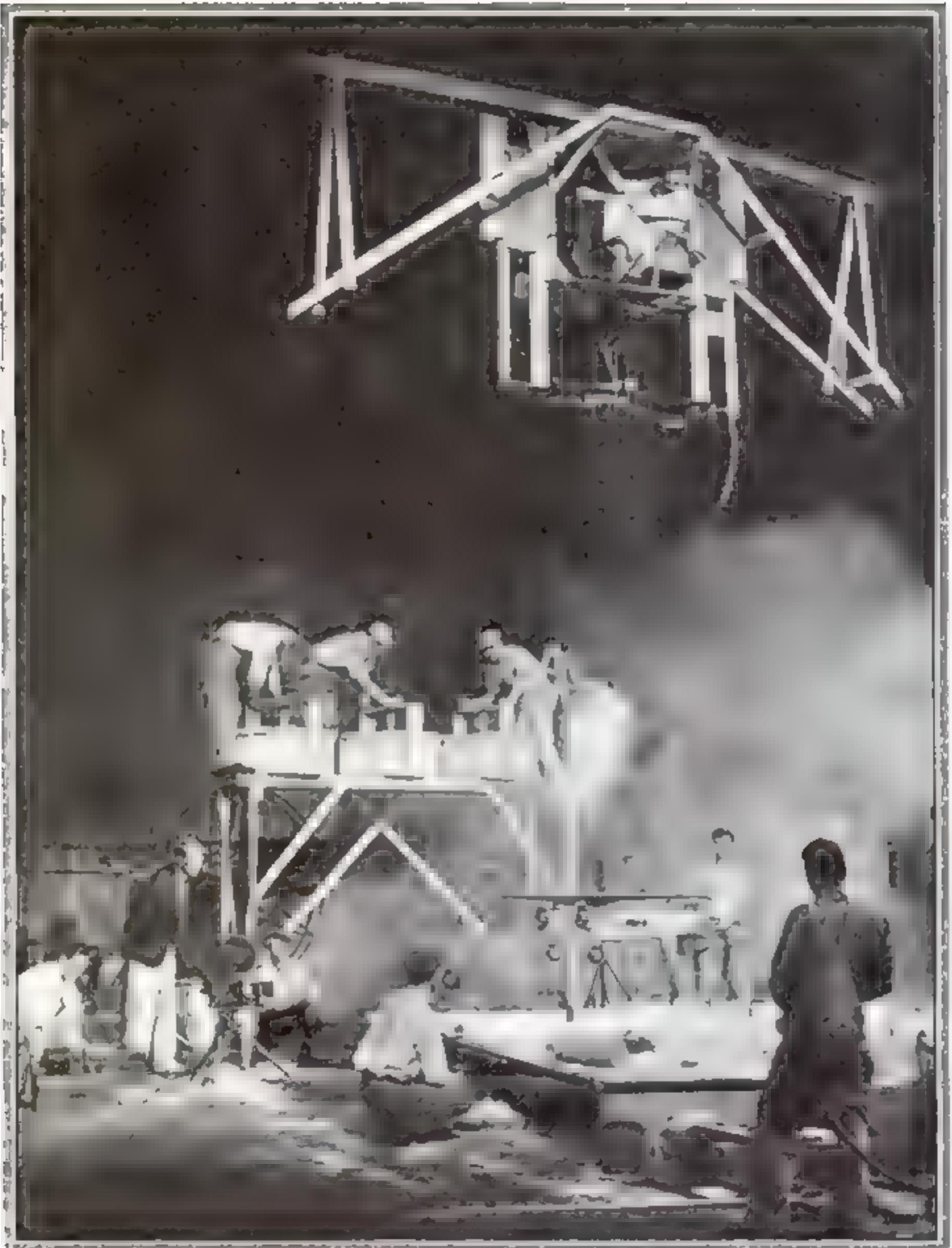
In a recent issue of *POPULAR SCIENCE MONTHLY* there is an article entitled "America's Crookedest River Is Mapped." The illustration does not give the whole river, but what is evidently the crookedest part, stating it runs twenty miles to advance only six. Here in Massachusetts we have a river that beats it. The Charles River is claimed by our people to be the crookedest river in the country, and here are some of the figures to prove it. Total length, 85.76 miles. Air line, 25.80 miles. Across Wellesley Neck, air line, 3.49 miles. Around by river, 23.05 miles. Dedham, or Long Ditch 0.74 miles. Around by river, 0.16 miles. Another interesting feature of this crooked river, is that at Dedham, it loses one third of its water via Mother Brook to the Neponset River. In its total length it is as crooked as the selected part of Nohn River, and in places, it is crookeder.—D.W.N., Wellesley Hills, Mass.

Grandpa's "Jolly Rocker" Makes Three Sets of Twins Happy

I BOUGHT a copy of your April number and was very much interested in the "Jolly Rocker." I begged some discarded wheels, took them apart, and used the fittings. Since then I have made and given away six "Jolly Rockers" at a very small expense. The funny part is I have given them to three sets of twins. They were boys aged about six, nine, and eleven. The "Jolly Rocker" is a great joy producer fits any age, and with discarded wheels lying around everywhere one can use scrap lumber, nails, and permutation and set Rockers & rocking. That is my experience and I am only eighty-two.—A.E.W., Newark, N. Y.

WHEELS





Puppet Planes for Tragic Scenes

Skill in the use of toy planes has added new thrills to the movies without endangering the lives of actors. Suspended in air and worked by many invisible strings, the little planes go through their amazing stunts while the cameras grind, and no realistic detail is lacking to the startling scenes. See page eighteen for full description.



POPULAR SCIENCE

MONTHLY

November 1932

Vol. 121, No. 5

RAYMOND J. BROWN, Editor



SIXTY FIRST YEAR

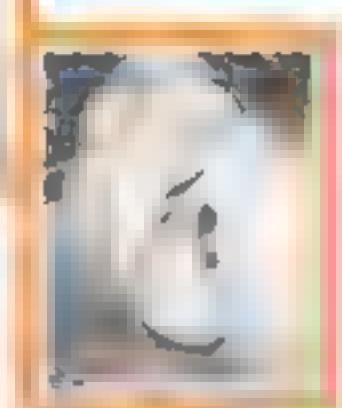
* *Amazing Facts Discovered by a Famous Physician Arm the Police with a Mighty New Weapon Against Crime*



Spot Crooks *by their EARS*



Two distinct types
of ears are seen here by
Dr. Theron W. Kilmer,
New York physician, in his
work against crime.



A TEN-YEAR search for two ears just alike has led to the discovery of a new weapon against crime. The other day, Dr. Theron W. Kilmer, noted New York physician, told police officials at the seventh annual convention of the National Identification Association, meeting in New York City, of discovering a "criminal ear" that appears twice as often among gangsters, thieves, and thugs as among honest citizens.

In addition, he has worked out a system of classifying ears as an aid to trailing wanted men. Because of his researches, such strange terms as "flap ears," "earographs," and "one-o'clock ears" may soon hold important places in the vocabularies of American detectives.

For when Dr. Kilmer speaks, police officials sit up and take notice. His studies in connection with the life-saving and identification branches of police work have brought him honorary memberships in such organizations as the New York State

By EDWIN TEALE

I remember one famous New York detective who told me that he made most of his captures of wanted men by recognizing the backs of their heads. He didn't know why it was easy for him to remember people he saw in police lineup that way, but he knew it was. Inasmuch as the ears are one of the most prominent features of a head seen from the rear, this detective was probably unconsciously making use of Dr. Kilmer's plan of identification by ears. In Paris, as an aid to French detectives, the rogues' gallery contains rear views of the heads of criminals as well as front and side views.

If Dr. Kilmer's discoveries are applied by criminologists, the chattering teletypes and police radios of the future may broadcast descriptions of fleeing criminals that contain some such sentence as this:

"Watch for this ear! Flap, Lobeless, Eleven-O'Clock, Round, Shut."

Those cryptic words will mean much to the detective trained in the ear classifications worked out by Dr. Kilmer. There are five divisions.

In the first, the ears are divided according to their position on the head as seen from the front. "Close" ears are those that lie comparatively flat against the head; "flap" ears those that stick out. The second division contains the "lobeless" ears, ones growing right out of the skin above the

WHAT TIME IS YOUR EAR?

The drawings below give you a clear idea of the various types of ears and will enable you to pick your type.

FIRST FULL PRESENTATION OF NEW IDENTIFICATION SYSTEM

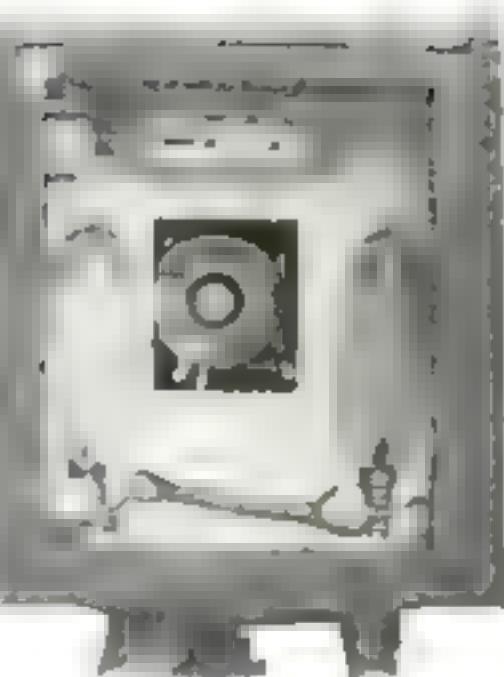
AS WE go to press, Dr. Theron W. Kilmer is telling the National Identification Association, meeting in New York City, the startling fact that he has discovered a "criminal ear." For over thirty-five years, Dr. Kilmer has been a prominent physician of New York City while his work in criminology has won him honorary distinction in Europe and America. It is thus a matter of great pride that POPULAR SCIENCE MONTHLY is able to give its readers the first complete report of the work done by this famous physician and student of human nature.

angle of the jaw and "lobe" ears, having the familiar fatty appendage at the bottom.

The third division denotes the manner in which the ear is attached to the head, that is, whether it is straight up and down, tilted forward or tilted back. The axis of the right ear is compared to the hour hand on the face of a clock. If the ear is straight up and down, it is designated as a "twelve-o'clock ear." If the top is farther ahead than the bottom, so the ear appears tilting forward, it is called a "one-o'clock ear," and if it tilts back, it is an "eleven-o'clock ear."

The general shape of the ear, either "round" or "elliptical," forms the fourth division. The fifth designates whether the canal, or opening, of the ear is visible in a side view. In "open" ears, the canal is visible; in "shut" ones, it can not be seen.

By broadcasting such information, the search for a



At right the interior of the earograph camera. Left two photos of the same ear and below them, picture showing how the two negatives coincide when one is laid on top of the other.

wanted man is instantly narrowed down. Just as an officer on the lookout for a stolen car with an Indiana license plate ignores similarities with other plates, so the detective searching for a criminal will eliminate all suspects with entirely different ears, thus saving time and avoiding the arrest of innocent persons. And, while an auto-thief can change his license plates, a criminal can't change his ears to disguise himself.

The chances of an innocent person having ears that tally in all five respects with those of a wanted criminal are slight. Even then, the exact negatives of the "earograph" camera would expose the differences between them.

It is often impossible, in the work of identification, to get a good look at a person's face. Again, he may be sitting down so an estimate of his height and weight will be difficult. But one glimpse of an ear may settle his identity. By means of this clue alone, a sleuth can often pick his man from a throng of people.

Besides aiding in the capture of criminals, Dr. Kilmer believes his researches will help in identifying victims of violence and missing persons and may also play an important part in kidnaping cases. His tests have shown, he told me, that the human ear changes little from childhood to old age. He has compared pictures of children's ears with the same ears later in life. During his decade of research, he has repeatedly examined and photographed the same ears and found they remained identical year after year. Thus, a person kidnapped in childhood and recovered years afterwards, might be identified by his ears.

Families, he also learned, have similar ear traits that show relationship to the eyes of the expert. In addition, his investigations have exploded the old theory that an ear without a lobe indicates degeneracy. There is no basis in fact, he told me, for this belief.

A few years ago, a bullet-riddled body was found on the outskirts of Chicago. It was thought by the police to be that of Frank Foster, notorious gangster then wanted in connection with the "Jake" Lingle slaying. (*Continued on page 105*)

Eight-foot model of tri-motored transport suspended by wires lands on "snow" field, as producer studies it

Startling Movie Stunts with Toy Planes on Strings

By ANDREW R. BOONE

PUPPET airplanes, looking exactly like full-sized machines ready to fly, now take the place of real planes in filming movie air stunts. On great sound stages, they are always under control, ready to "fly" through fog and storm and snow or to be photographed against mountain and cloud backgrounds for thrilling closeups in the air.

Whether tiny or large, the planes are suspended by wires and cables operated by a "pilot" who sits high above the stage in a discarded airplane seat, one hand resting on a conventional control stick with which he dips the plane, lowers the tail for landings, and otherwise manipulates the top plane as though a pilot were flying it free from outside control.

Thrilling evolutions are performed by these puppets. They dive on a tiny field covered with snow-like gypsum, crash through hangars, explode and burn more realistically than full-sized ships could be crashed by stunt pilots. And they're always under absolute control, ready to do the director's bidding.

Recently I was privileged to witness the making of nerve-tugging scenes at Universal City, while "Air Mail" was in preparation. One full-sized plane actually crashed on a "snow" covered set on the back of the lot; another hung from the roof of a dark stage and was rocked gently by a carpenter standing at one wing as two actors fought "in the air"; other miniature planes, having a wing spread no greater than eight feet, roared down through a storm to land, bouncing, on a snow-covered airport as three property

men cranked breached corn flakes down from as many hoppers and two wind machines blew this "snow" in a wild flurry across the airport.

Many technical problems are involved in making these scenes. A full day may be spent taking and retaking a single scene showing a tri-motored transport gliding through a storm for a landing on the raised platform that looks like a desert landing field. Out of the lot John Fulton, who makes these special effects, may get a single thirty-foot sequence that can be used in the finished picture.

Fully a dozen times during one morning recently, while I sat on a tool box behind Fulton's squat camera, pointed from near the door up over the "field"

SLIDES DOWN A WIRE TO PERFECT LANDING

This little plane makes a perfect landing in the "snow" because it is gliding down a wire run through screw eyes in its fuselage. At right, with a miniature mountain as a background, the tiny plane tandem to a thrilling crash that perfectly emulates the real thing without endangering the life of the daring actor-pilot or technician.

Dummy Plane with Dummy Pilot Pictured in Realistic Crash



CRASHING A MOVIE PLANE

Paused on a foot-high platform, right, the dummy plane is ready to crash in front of the cameras. Far left, in place of the pilot is the dummy figure seen above. As the plane drops from the platform, it lands on the exact spot covered by the cameras and below it is seen in its wake the dummy, extricating himself from the wreckage of the cockpit.



Photos taken especially for
Popular Science Monthly
by Universal Pictures

toward the incoming plane, this technical director filmed the miniature ship as it came over at various altitudes and speeds, darting through fog that filled one end of the curtained room, sliding down through the snow, and whizzing past our ears to the end of the 200-foot runway.

Suspended from fifteen tiny and invisible wires, connected in groups of three with his controls sixteen feet above, the little ship looked like a giant airliner dipping through the gloom. Possibly you can get the picture better if I carry you with us through one sequence.

Perched in his chair in a complicated wooden framework attached to a monorail running the length of the sound stage, one of the stage hands quietly awaits the order to "come through." One hand rests on the control stick, connected with thwartship and fore-and-aft wooden bars from which the plane is suspended. By moving his hand to the right, the right wing is depressed. By pulling the stick back, the tail settles and the plane prepares to land. And since the entire framework is counterbalanced, the operator lowers the plane by pulling down on a large rope hanging alongside.

Little mounds of salt and gypsum dotted the fifteen-foot airport; a barbed-wire fence, perhaps three inches high, marked the far boundary; from a tiny tin barrel, hardly larger than an ink bottle, flames leaped and black smoke trailed away toward the roof. Bright sun arcs cast eerie shadows across the airport.



From the heights came a voice. "How do you want the 'props' to turn, John?"

"Better idle them for the landing," Fulton replied.

The assistant flipped a switch, connected through the tiny wires to motors turning the propellers. Through the shadows I could see them flashing.

"All switches on," shouted the assistant.

"Give us some clouds," Fulton demanded. Two workmen, carrying pots resembling blow torches connected with compressed air hoses, waved the pots around the room between the camera and the plane. As the room filled with tiny globules of liquid clouds, the workmen ducked out of sight.

"Okey," Fulton exclaimed. "Now start the snow."

The whirling wind machines began to blow the corn flakes across the set. There before our eyes a snow storm whipped the lonely port as the single oil barrel invited the troubled air liner down to safety. Everything was ready for the plane to land.

"Let 'er come," Fulton shouted, as he bent down to peer through the finder at the puppet plane.

The plane, moving slowly at first, quickly gathered speed until it sped down the stage thirty miles an hour. An endless steel cat wrapped around a steel drum turned by electric motor, pulled the plane and its controlling apparatus along. Any of 210 speeds, from one-seventh mile to thirty miles an hour, are available, merely through a turn of a switch.

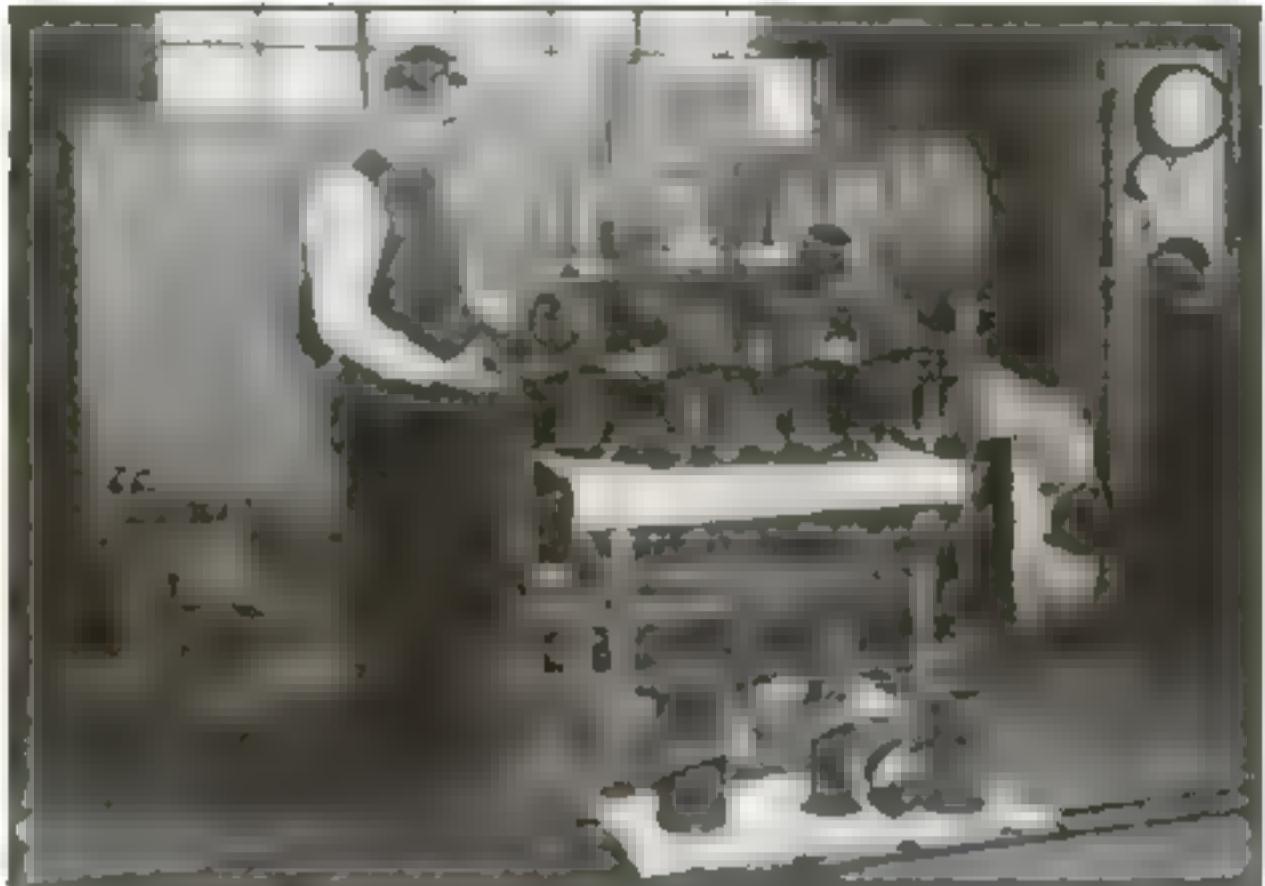
I have seen many great liners of the air settle on hard runways at night. Never though, have I seen a landing more realistic than the noiseless glide of the eight-foot miniature. When it started, possibly a hundred feet from the little airport, I could see its running and landing lights poking their way through the man-made storm. Gradually the plane itself took shape and finally, as it sped over the port in a first try at the field, the profiles of pasteboard figures were etched against tiny lights within the cabin. All these things the camera saw and recorded more faithfully than it could a similar landing in a real storm of a plane ten times as large as this one. (*Continued on page 106*)

USE MODEL OF BIG LOCOMOTIVE TO SOLVE RAILWAY PROBLEMS

To solve railroading problems, engineers of the University of Illinois have set up in their laboratory an imitation locomotive. This unusual model is a quarter-size reproduction of the front end of a heavy Mikado-type locomotive that puts like a real engine but never goes anywhere. An observation peephole enables the experimenters to see what goes on inside the model. In one series of tests, the efficiency of 186 different shapes of smokestacks was compared, and accurate data have been obtained. Instruments make record of steam flow and atmospheric conditions.



Light automatically grows behind the map below as indicated by arrow of station from which red a problem is being tested.



Imitation locomotive, in background, used in laboratory tests of smokestacks.



RADIO LIGHT GIVES PROGRAM SOURCE

A radio set that shows at a glance the source of a broadcast program is the invention of a young Milwaukee, Wis., electrical engineer. On top of the set is mounted an illuminated map of the United States. When the user of the set tunes in a station, a lamp bulb automatically flashes behind the map at the point where the program originates. Thus it is unnecessary to wait for the station announcement to learn what station is being heard, a fact that would save much time when a particular station is sought. Lamps are provided upon the map for the majority of the country's important broadcasting stations. Except for this unusual attachment, the set, in outward appearance, resembles a standard instrument and is tuned with a single knob.

MACHINE STEAMS PAPER FROM WALLS



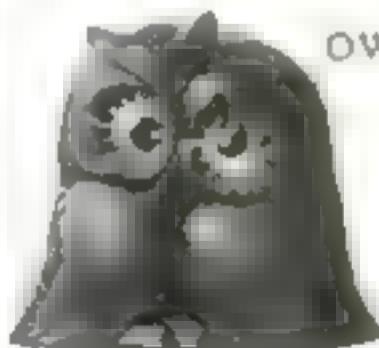
This machine supplies steam that removes old wallpaper.

Old wallpaper is removed rapidly by a new portable machine designed especially for the purpose. Its oil burner generates low pressure steam which is applied to the paper through a fixed applicator. The steam seeps through the adhesive and the paper peels off. According to the inventor, one man with the machine can wash down three walls in fourteen hours per day. The device may also be used for drying out rooms after painting. An attachment is provided to wash walls of color wash.



NEW HOLDER ENCLOSES ENTIRE CIGARETTE

Sparks and ashes cannot flick from the end of a cigarette when it is enclosed in a new safety cigarette holder, shown above open and closed. According to the New York inventor, it should prove especially useful to motorists. While being smoked, the cigarette is completely enclosed in a folding shell that admits air through perforations. The angled cigarette may even be puffed in the pocket.



OWL CLOCK'S EYES TELL TIME

OWL-SHAPED, with revolving eyes that tell the time, is an amusing clock made in Germany. Hours are read at the left, as you face the owl, and minutes at the right. Thus in the photograph, the eyes indicate that it is three o'clock. No numbers are on the dials, as one mentally associates the numbers with the proper spacings.

New Gyroscopes BALANCE ITALIAN LINER

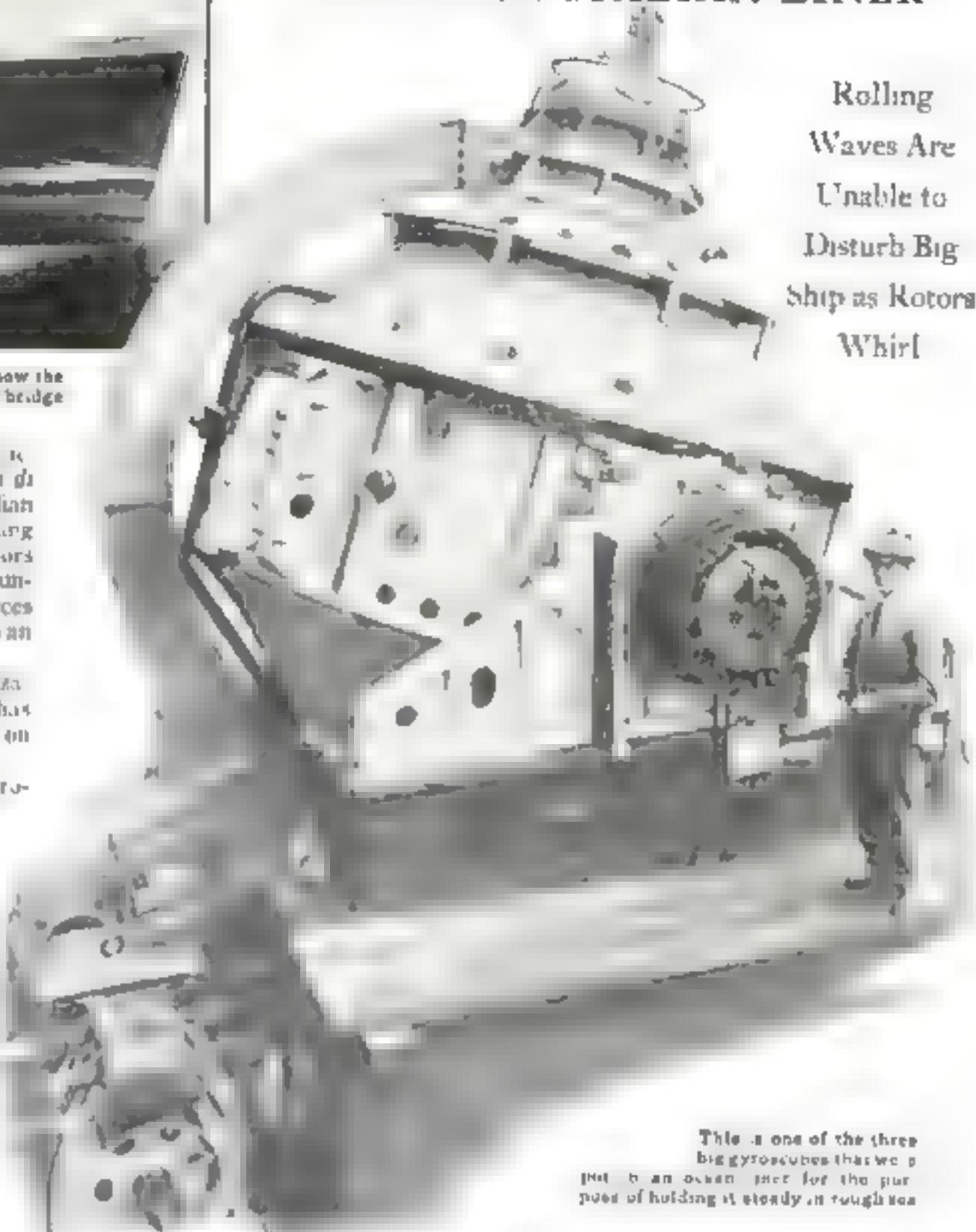


Cutaway drawing of Italian liner showing how the gyroscopes were installed in hull, aft of bridge

SPEEDING across the North Atlantic near the end of November, the *Costa di Savoia*, newest and second largest Italian luxury liner, will pay little heed to the rolling of the sea. Three giant gyroscopes, with rotors thirteen feet in diameter and weighing a hundred tons, will counteract the disturbing forces of the waves, holding the 49,000 ton ship to an even keel.

For the first time in history, gyro-stabilization, long used on warships and yachts, has been applied for the comfort of passengers on a giant ocean liner.

In operation, a small, sensitive pilot gyroscope detects the first keeling impulse of a wave, and through relays and a geared precession motor, causes the stabilizing gyros to begin tilting, in a fore or aft direction, from the vertical. As long as they are tilting, the gyroscopes counteract the force of the waves.



This is one of the three big gyroscopes that are to be used on ocean liner for the purpose of holding it steady in rough seas.



MIDGET POST OFFICE HAS PHONE BOOTH

COMBINATION post offices and phone booths are now the style in England. At the compact booth illustrated, in Birmingham, a person may obtain stamps, mail a letter, or make a telephone call to any point in the country. The booths are being erected at convenient locations on the city streets.

PARIS CAFE GIVES DINERS "AIRSHIP" RIDE



Patrons of this Paris cafe get the thrills of a transatlantic air trip as they sit in a reproduction of an airship while the scenery moves

To give its patrons some of the thrills of a transatlantic air voyage, a Paris cafe has installed a reproduction of an airship and control cabin in its dining room. The controls operate a moving panorama on the wall, whose changing scenery provides the illusion that the onlooker is traveling from Paris to New York. The trip takes fifteen minutes. Waiters and other employees in the restaurant are appropriately dressed as stewards, complete with their buttons and gold braid.

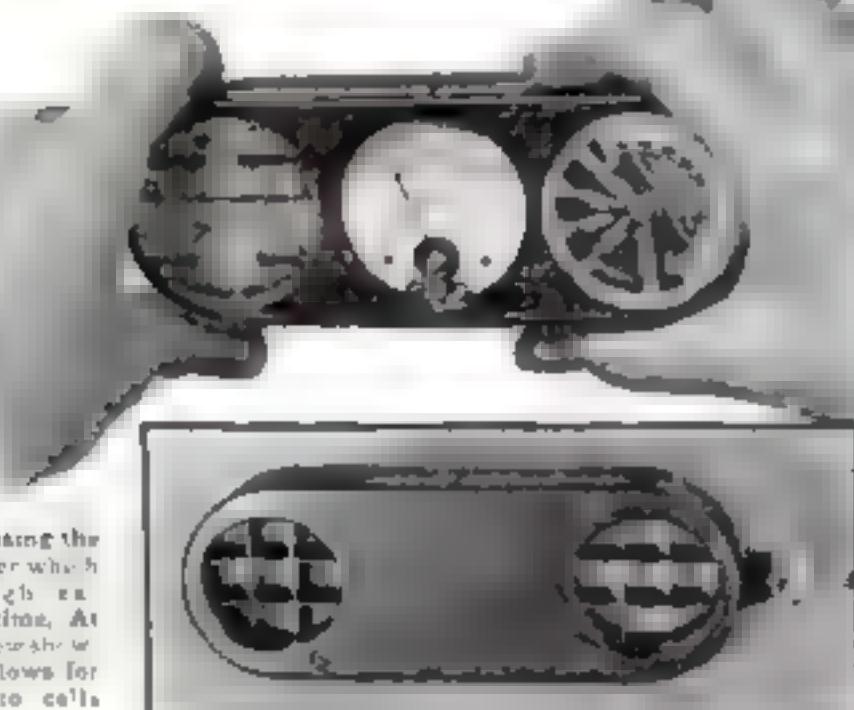
NEW FILM WILL PICK UP FINGERPRINTS



FINGERPRINTS literally are lifted off objects near the scene of a crime in a new process invented by Alton K. Fisher, assistant in anthropology at the Milwaukee Wise, Public Museum. Speedy and accurate, the new method may supplant photographing the tell-tale prints. Police officials hail it as an outstanding advance in criminology which will prove of great assistance.

"*Nano oil*," which dissolves the surface layer. The dissolved side is then pressed against the fingerprint, which has been dusted with lampblack or aluminum powder. After drying ten minutes, the film may be peeled off. It takes the print with it, so thoroughly incorporated in the film that not even a trace is left on the original object. The resulting film record is convenient to handle and virtually indestructible.

ELECTRIC EYE GIVES CORRECT PHOTO EXPOSURE TIME



Above, using the new meter which gives exact exposure time. At right, launching windows for the photo cells

GUESSWORK is removed from picture-taking by a new meter that automatically reveals the correct exposure to use. A pair of photoelectric cells in this device measures the intensity of the light, which is indicated in units of light value by an electric needle on a dial. By referring to a table beside the dial, the proper exposure corresponding to the light value is found. Pressing a button on top of the instrument amplifies the swing of the needle exactly ten times for convenience in testing the comparatively weak strength of artificial light. While the new instrument is of more expensive design than other exposure meters of less precision, its first cost is its last, and it is built to last practically a lifetime, according to the maker who says its accuracy makes up for its cost.

Trace of lifted Fingerprints 14 to 16 mm. long and 1 mm. wide
Fingerprints are lifted
without damage to the
surface. They are
easily identified
and can be easily
lifted again if necessary.



SAFE TRAY FOR SMOKERS

FORGOTTEN cigarettes can do no damage when they are left lying in a new glass ash tray. A close-fitting groove in each rest puts out the cigarette before it burns down far enough to fall off the tray and mat a table top or upholstery.

BOTH ENDS OF LIFEBOAT RELEASED AT SAME TIME

A NEW releasing mechanism for lifeboats was successfully demonstrated in New York the other day. The device was invented by H. J. Ferguson, First Officer of the S. S. *Duchess of Atholl*, to avert danger of capsizing at the moment that the boat casts loose. When the lifeboat reaches the water, a pull of a lever releases fore and aft davit cables simultaneously. A connecting rod, which runs along the bottom of the boat, operates both releases at once and virtually makes an accident impossible.



Demonstrating the launching of a new lifeboat that has a connecting rod along the bottom by means of which both ends are freed at once

AMERICAN BUS CAN RIDE ON RAILROAD OR HIGHWAY

A MOTOR bus that rides on roads or rails with equal ease was demonstrated in Chicago the other day. Small flanged guide wheels, let down before and behind the main ones by a control beside the driver's seat, keep the odd vehicle on a railroad track as it rolls along on its rubber tires. While the first model was for passengers, others may carry freight. The road-or-rail coaches could be loaded at a factory, driven to a railroad, and formed in trains to be hauled to their destination, where they would leave the rails and proceed individually to consignees' doors. The buses would serve as passenger vehicles on branch roads. British lines have been trying out a somewhat similar vehicle for this purpose, known as the "ro-trailer" (P.S.M., Apr., '31, p. 33).

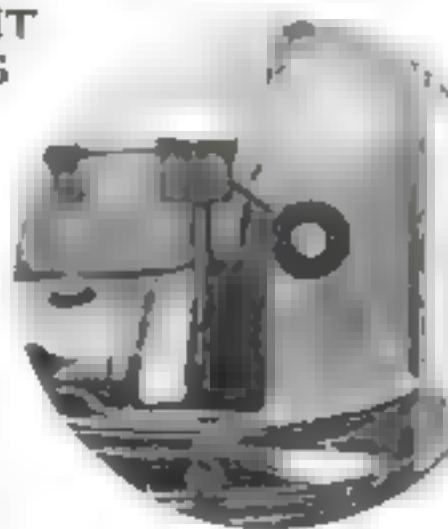


This new bus, recently tried out in Chicago, is equally at home on steel rails or the paved thoroughfare

At left, view of the two flanged wheels that drop down to build tire on railroad track and are raised when vehicle is on highway

NEW AUTO STOP LIGHT WAVES ITS WARNING

A NEW rear stop light for automobiles attracts attention by swinging back and forth like the red warning signal at a railroad crossing. A small electric or vacuum windshield wiper motor operates the arm to which the light is attached. The switch or operating valve is connected to the foot brake so the light flashes on and begins swinging automatically when the brake pedal is pressed. The moving light, it is expected, will be more readily seen than the stationary kind.



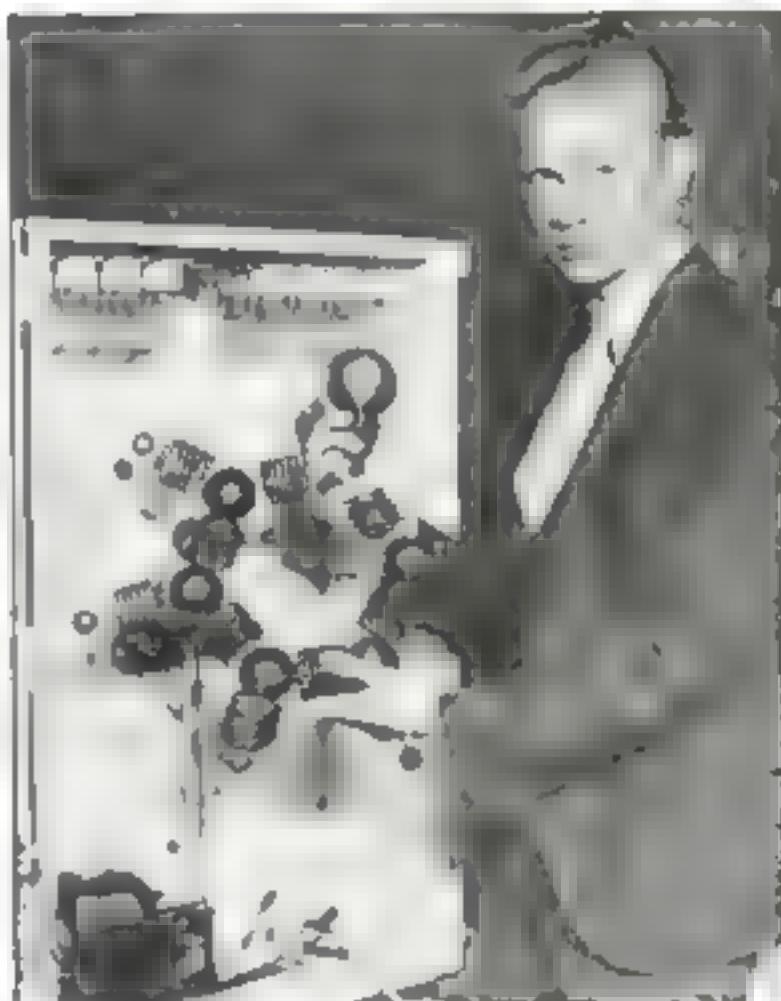
Auto stop light swings its red warning

BOUNCING BALL TESTS POWER OF VOICE



Power exerted by singer's voice is tested with this ball

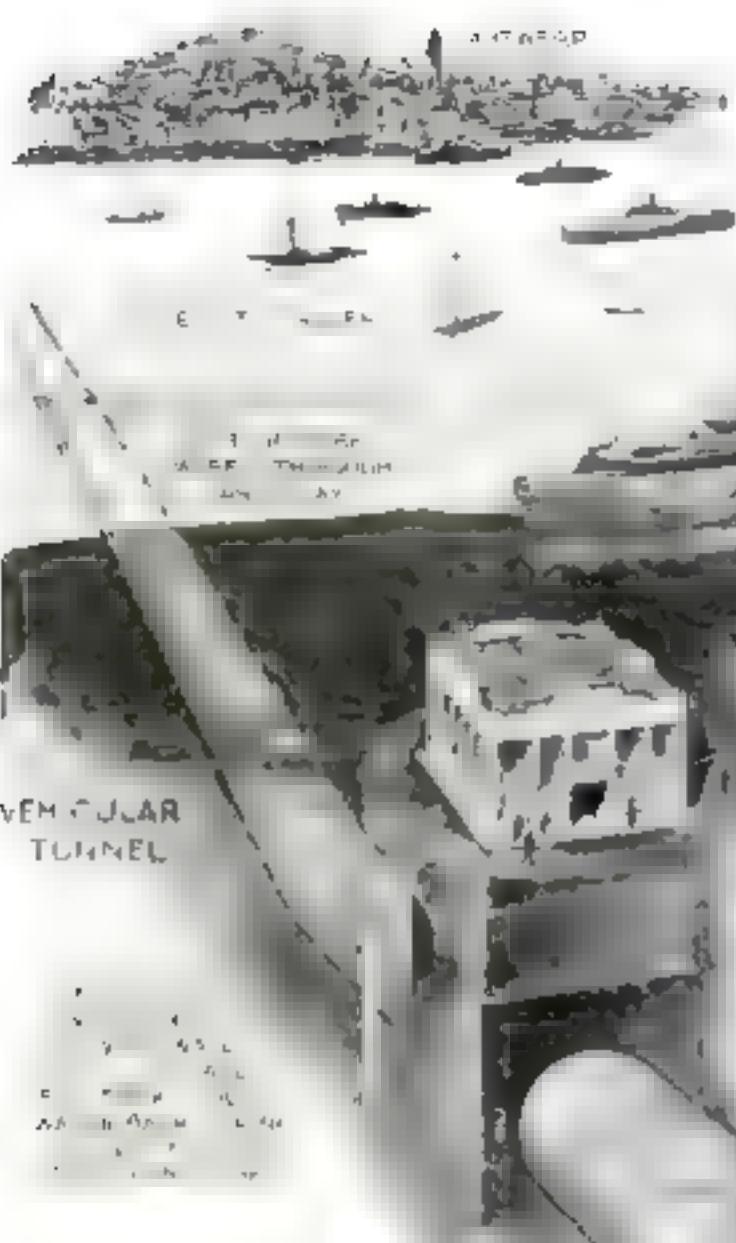
A SINGER'S lungs need furnish only a trifling amount of air to fill a concert hall with sound, recent experiments indicate. To test the power behind the human voice, subjects at the phonetic laboratory of Hamburg University, in Germany, were asked to sing into a bouncing-ball device resembling a familiar child's toy. A typical singing voice proved capable of lifting the ball, which weighed half a gram (roughly, $\frac{1}{50}$ th of an ounce), to a height of seven centimeters (about 3 inches).



Unusual model of chlorobenzene molecule. Balls are atoms

ATOMS IN MODEL OF MOLECULE BEHAVE LIKE REAL ONES

Model molecules behaved like real ones before a recent scientific meeting at Denver, Colo. They were built by Prof. Donald H. Andrews, of Johns Hopkins University, to test the theory that molecules are made of atoms lashed together by forces like springs. Engineers under his direction put metal balls and spiral springs together. Each ball represented an atom, and its size was in proportion to the atom's weight. When the models were shaken at different speeds by an electric motor they gave vivid proof, according to Dr. Andrews, of the accuracy with which science has pictured molecules. A model of a water molecule, for example, proved to have three vibration points. It was found that these corresponded almost exactly with three lines in the spectrum of water, believed to represent vibration points of the actual molecule.



Quicksands

Picture shows how easily it is to sink shafts in quicksand. But water is shown as solid.

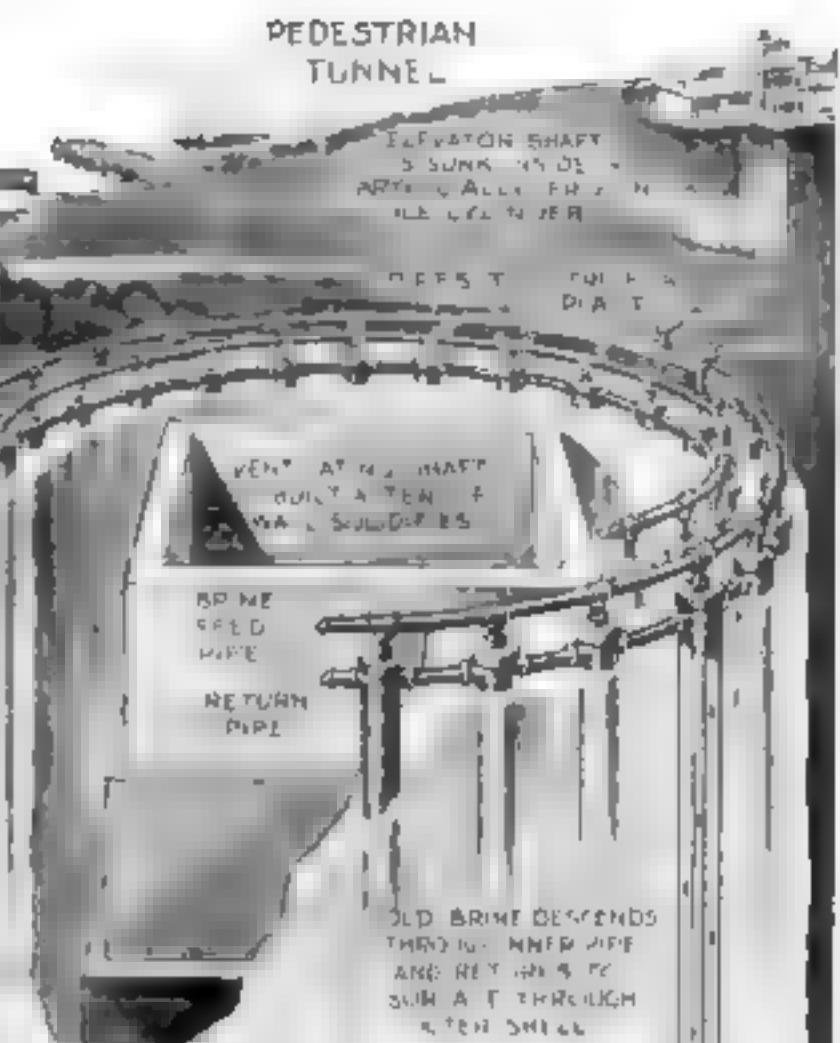
By JOHN E. LODGE

UNDERGROUND shells of ice as well as seven-story buildings are helping to construct a pair of tunnels beneath the Scheldt River at Antwerp, Belgium. When engineers were faced with the problem of sinking ventilating and elevator shafts through fluid quicksand, they decided to freeze it! Their success in forming artificial ice barriers to keep water out is attracting world-wide interest, since the unusual engineering technique may be applied to good effect elsewhere.

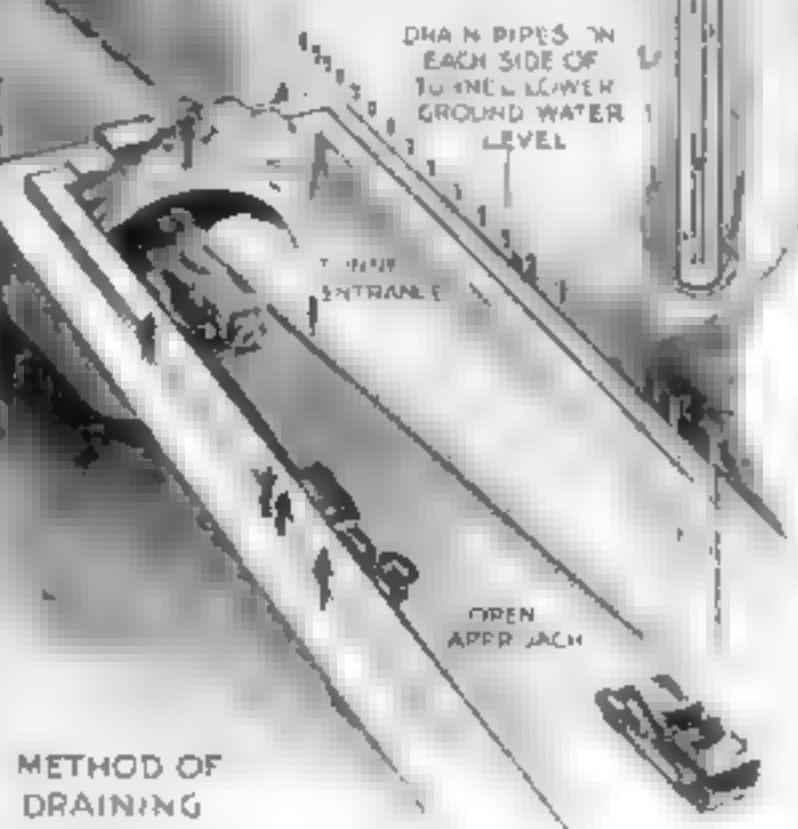
Belgium's two new tunnels—one for automobiles and the other for pedestrians—will give the 400,000 inhabitants of Antwerp more elbow-room. Further growth of the city on the right bank of the Scheldt is impossible, but across the river is a wide area to which the tunnels will give access.

The vehicular tunnel will have a terminal diameter of thirty-one feet. Its two-lane roadway will carry 7,000 vehicles an hour. Between portals the tunnel will be no more than a mile long. At its lowest point it will dip ninety feet beneath the surface of the Scheldt. The pedestrian tunnel is much shorter, measuring 1,750 feet from end to end. Elevators instead of long approaches with gradual grades will give access to this. Both tunnels traverse hard clay, offering no unusual construction difficulties for most of their length.

To reach this underlying clay, however, the tunnels must pass through a veritable quagmire on the left bank of the Scheldt.



HOW ICE SHELL
IS FORMED



METHOD OF
DRAINING
TUNNEL
APPROACHES

Here the low-lying land is composed of muddy flats and sandy stretches that rise only a few feet above the water at high tide. Accordingly one has little more to do than scratch the ground to teach water

At the open-cut approach of the vehicular tunnel, the engineers sank shafts along the sides. Electric pumps, placed in the holes, soon lowered the underground water level sufficiently to keep water out

of the cuts while work was in progress.

This method, however, did not suffice to keep water from flooding the deep ventilator and elevator shafts that descend as far as ninety feet through quicksand to the tunnel bores. Americans would sink such shafts with caissons, under air pressure. The Belgian contractor chose a novel method that takes longer, but saves money and material in the end. He elected to

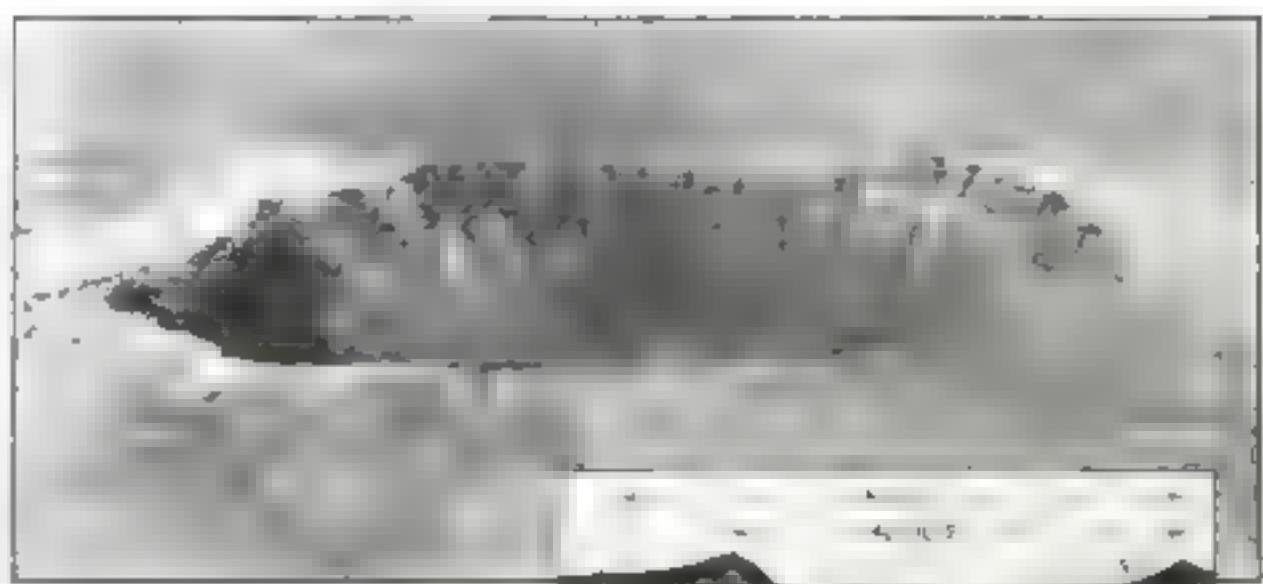
Frozen to Dig Tunnels

Engineers Startle
World with Casings of
Artificial Ice Around
Ninety-Foot Shafts

freeze the ground, forming a rigid cylinder of frozen earth around the site of each of the deep shafts. Thus he demonstrated in practice the use of ice as a structural material, an idea already proposed and discussed by scientists (P. S. M., Sept., '32, p. 33).

Around the site of each shaft were first sunk about 120 holes in two concentric circles—the larger circle eighty-six feet in diameter, and the inner one, ten feet smaller. In each hole was lowered a tube six inches in diameter and closed at the bottom. Then smaller pipes, with bottom ends open, were placed within the larger ones and the whole interconnected system shown in the diagram was filled with circulating brine from a refrigerating plant erected nearby.

Soon the fluid ground began to freeze around the pipes. Week after week the ice crystals spread until those from adjoining pipes met. Between three and four months from the time the brine was turned into the pipes, a single great cylinder of ice with walls fifteen feet thick surrounded the site of the shaft. So successfully has the man-made barrier kept out water that so far the digging has gone forward without difficulty. Since the frozen cylinder must be



FREEZING WATER IN ROCKS
MAY OPEN WAY TO METEOR
ABOVE, VIEW OF METEOR CRATER. AC-
CORDING TO THE SCIENTISTS, THE
WATER HAS BEEN CIRCULATING
IN A SYSTEM OF PIPES SINCE
THE DAY IT WAS DUG OUT.



kept solid throughout the work, the circulation of brine goes on constantly, while tell-tale thermometers keep tabs on the temperature.

It is a long way from Antwerp to Meteor Crater, in the north-central section of Arizona, but it is suggested that the freezing method in use in the shafts at Antwerp may also be used in getting down through broken and water-bearing rock to a depth of 1,500 feet in quest of millions of dollars worth of nickel supposed to underlie that crater in the desert. Meteor Crater is 4,200 feet long and 4,000 feet across, and from rim to bottom of this vast bowl there is a drop of 570 feet. It is believed to have been formed a thousand years ago, when a meteorite earthward and a blow so

stupendous that it drove its way for more than 2,500 feet through solid rock and, in the course of a fraction of a second, excavated about 400,000,000 tons of rock!

Exploratory borings have brought up meteoric fragments rich in nickel; and the hidden mass has intrigued geologists, astrophysicists, and mining engineers.

Work to reach it was going forward confidently three years ago, and a test bore had been carried down about 600 feet when water unexpectedly and in large quantities entered the shaft. The pumps installed to handle seepage were unequal to the task, and the fine sand in the water soon incapacitated more powerful pumps.

Now an American expert, identified with the Antwerp tunnels, has said, that the freezing method used there probably can be applied successfully in getting through the troublesome ground at Meteor Crater.

Talkie Gets Horseless Carriage

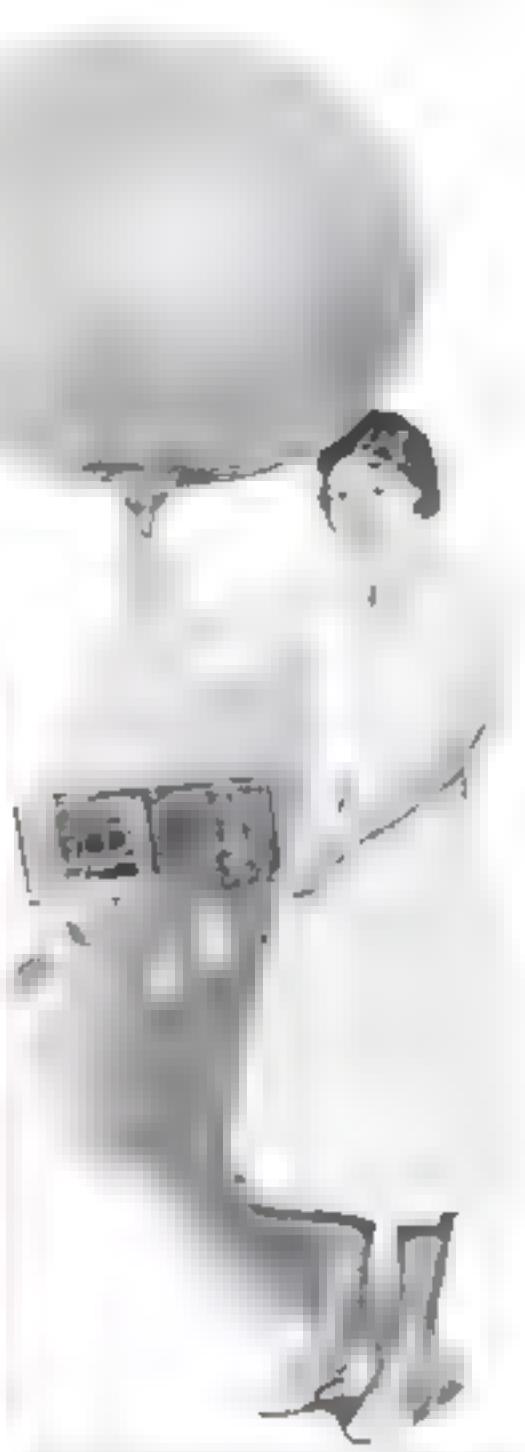
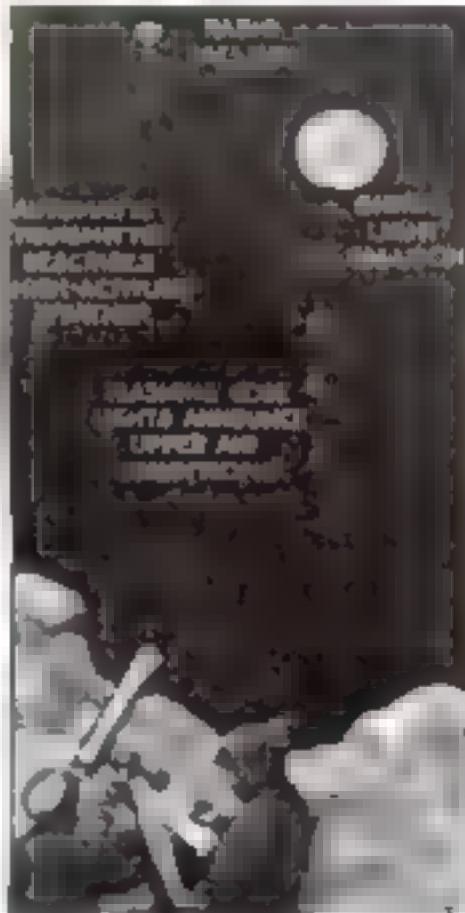


STEAM BOILER WAGON
CARRIED AND IS
BEING MADE FOR A TALKIE

A HUNDRED-YEAR-OLD horseless carriage, driven by steam, has been constructed in Hollywood, Calif., for use in a talkie. The studio mechanics constructed the machine from old drawings of an English "boiler wagon" that is said to have pulled along a road near London long before the first gasoline engine made its appearance. With throttle wide open, the 1932 version attained a speed of nearly five miles an hour on its initial test. The driver of this ancestor of modern motor cars grasped a horizontal steering lever in his left hand and a clutch lever in his right. The wagon wheels on the car were shod with heavy iron tires to withstand the bumping over cobblestone roads. Behind the upright boiler, a fireman, standing on a small platform, kept up steam to drive the original horseless carriage as it rumbled over English roads.

Balloon Radio Seeks Polar Weather Secrets

Close up, right, of radio sounder showing antenna and transmitter. Below, at left, Dr. F. W. L. Wherry, of the U.S. Botanical Survey, stands by the launching equipment.



A radio sounder on board a balloon to record atmospheric pressure and temperature and to report the readings to observers.

TWINKLING lights and radio signals will bring automatic weather reports from the upper air when the "International Polar Year" expeditions penetrate the Arctic in 1933. Two balloon-carried instruments to aid in gathering data have just been perfected.

Red and white electric bulb is dangled on wires from a wire-wound "radio meteorograph," which measures temperature and air pressure. Automatic contacts will cause the lights to flash on and off in code signals, reporting the readings at different levels. Observers on the ground will watch the rising balloon through a

telescope and interpret the signals. This device is the invention of a Canadian meteorologist. Another instrument will be an improved form of "radio sounder,"

devised by a Russian professor. It consists of a set of instruments and a miniature automatic radio transmitting set that broadcasts the readings to observers.



COOKING KIT USES NEW FUEL

FUEL in paste form, made of solidified alcohol and packed in convenient tubes like shaving cream operates a new miniaturized cooking kit. The outfit includes a folding stand to hold a pot and a small burner. Pressure on a spring lever opens the burner for filling the fuel reservoir. The burner top does not close air-tight, but allows air to enter around the lower edge for combustion.

ACCIDENT FINDS "LOST" PLANT

By a lucky flick of his flashlight, Dr. Edward T. Wherry of the University of Pennsylvania, recently re-discovered a plant that had been "lost" for 125 years. This rare variety of "alum root," a name that is applied to a number of species, was originally discovered by the German botanist Pursh in 1817. Believing that it could be found growing in America today, the University of Pennsylvania botanist led an expedition to White Sulphur Springs, Va., in search of it. The hunt was fruitless until Dr. Wherry accidentally struck his flashlight button as he plodded through the darkness. Beneath the lamp's beam was the lost plant.





Guns and Bars Guard U. S. Crop Reports

GUNS and barred windows will henceforth guard the U. S. Department of Agriculture's seasonal crop reports from prying eyes, until they are ready for the public. The extraordinary precautions follow disclosures calling to mind war-time activities.

Some time ago a sensational "leak" of advance information on the cotton crop dismayed Department officials and precipitated an investigation. Corrupt employees of the crop reporting board according to the testimony, used window shades of the board room to signal observers across the street. If a certain curtain went up, the crop was better than expected. If it went down, the crop had failed. Unscrupulous speculators were alleged to have made fortunes in this way.

To prevent such leaks, the following procedure has been adopted:

Reports from individual states, on which the Department of Agriculture report is based, are sent under seal to the Secretary of Agriculture at Washington, D. C. He puts them in a strong box that requires two keys to open. The Secretary keeps one key; the other is held by the chairman of the crop reporting board.

When the day chosen for the national report arrives, the chairman goes with an armed guard to the Secretary and obtains the state reports. He brings them back to the board room, where members of the board and their statisticians are already assembled. While the national report is being prepared, occupants of the room are completely cut off from the outside world. Shutters on the windows are closed, and are kept inviolate by a new device worked out by the Department's mechanics. This consists of a wooden bar holding the shutters flat, secured at one end in a metal slot and at the other with a hook and a wire that cannot be removed without destroying a seal. Policemen stand

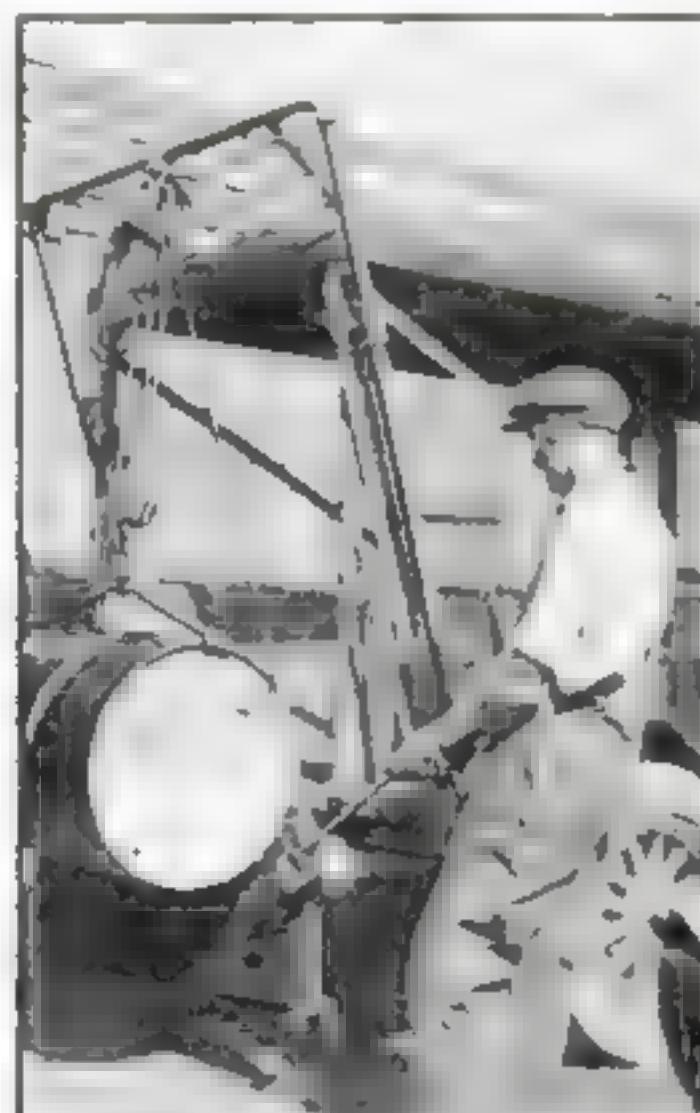


on guard at the door with revolvers. Then newspaper reporters are ushered into a room equipped with a battery of telephone and telegraph instruments. At a given signal, they pounce upon copies of the report. A second later, its contents are being flashed to every part of the country.



SNAKE TIES ITSELF IN KNOT TO CURE INJURY

A SNAKE became its own surgeon in a remarkable feat observed not long ago by R. S. Walker, Chattanooga, Tenn., naturalist. When this snake was captured its back was found to have been broken. The body drooped limp below the injury. The snake was placed in a hibernating box and left for several days. When it was withdrawn, the snake was found to have tied a knot in its body at the point of the injury. The knot held the fracture until it healed.



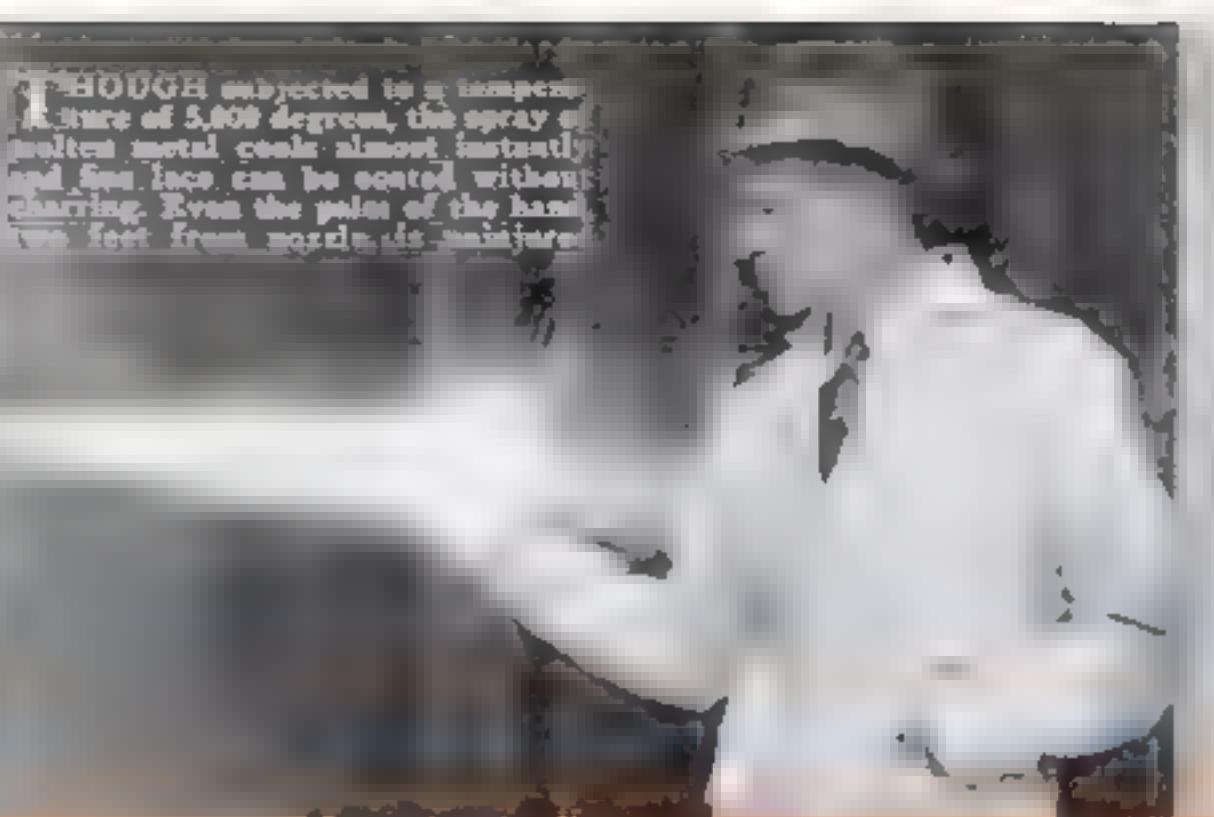
USES TRUCK ENGINE TO LOAD BARRELS

A IOWA STATE boy operates from the rear of his truck helps Frank McDonald of Portland, Me., to load 500-pound barrels of cod liver oil a year. The barrels are left for him on the wharves by fishing vessels. To ease the task of loading them, McDonald mounted a special device at the front of the car taking the motor's crankshaft and fitting it where the crank handle is usually inserted. By means of gears and a winch he transmits the power to a hoisting rope at the rear of the truck. A switch permits the operator to stop the motor.





THOUGH subjected to a temperature of 5,000 degrees, the spray of molten metal cools almost instantly, and fine lace can be coated without burning. Even the palm of the hand two feet from nozzle is uninjured.



S NEW TOOL, like Paint Gun, Sprays Mist of Molten Metal

HISSING determinedly and spouting a tiny flame, a tool, looking not unlike a paint sprayer, moved slowly back and forth over openings in stencils fastened to long panels of shiny metal. Not paint, however, was being applied to decorate these sections of aluminum doors and door frames that soon would be part of an ultra-modern New York skyscraper. The fine spray, leaving a glittering trail as it passed, consisted of atomized particles of molten bronze forced out by air pressure.

A thousandth of an inch thicker at each pass the strange tool was building up an inlaid design of genuine bronze, joined as permanently to the aluminum base as if it were welded there.

One more had been added to the scores of recent applications of sprayed molten metal—an almost miraculous process that has long been making revolutionary advances in industry, and more recently in pottery and sculpture.

From bolts to bridges, from small refrigerator coils to huge storage tanks and steamships, sprayed metal coatings now protect iron and steel equipment from destruction by corrosion. Aluminum coatings, by no other means commercially applicable, are being given wholesale to furnace grate bars, locomotive and steamship boiler tubes, ovens, electric heater resistances, pistons and explosion chambers of internal combustion engines, glass-making tools, and varnish kettles. Tin is being applied by this method on great cooking vats. Copper and lead coatings are being sprayed by this new process on

glass and other di-electrics to form the plates of electric condensers.

Unable with existing equipment to manufacture cable wires as long as were needed for the great span of the George Washington bridge, over the Hudson River, the builders were confronted with the problem of producing a joining device that would not reduce the strength of the wires and that would be permanently secure from corrosion. The ends of the galvanized strands were finally threaded and screwed into high-carbon steel ferrules. Permanently to exclude the effects of moisture, each of the several hundred thousand threaded ends and ferrules was sprayed with molten zinc—securing a better protection at the joints than that provided by the galvanizing on the regular stretches of the gigantic wire cables.

Not only zinc, aluminum, lead, and copper, but gold, silver, nickel, bronze, brass, iron, cadmium, German silver, stainless steel, and practically any other commercial metal may be easily applied by spraying.

In the field of ceramics, sculpture, and architecture, the use of sprayed metal opens wide new possibilities. Articles of pottery, coated with dull or shining metal instead of the usual glazes, are already attracting attention on the market. Decorative architectural pieces, cut in stone



OBJECTS OF ART AND INDUSTRY

By the new process, a coating of metal can be sprayed on lace, pottery, sculpture, or even the inside of pipes.



Remarkable Process Gives Metal Coating to Any Material from Steel and Sculpture to Fine Lace and Paper

or molded in one of the base metals, have been coated with metals such as bronze or aluminum. Plaster casts of statues may be so coated and finished that only with difficulty can they be distinguished from solid metal.

An amazing thing about the metal-spraying process is that the resultant coating is hard and cold almost instantly. Thus paper and delicate lace may be sprayed without the slightest charring.

The basic principle of this modern and far-reaching technical achievement, was worked out in Europe, but it was developed to its present state of perfection by American engineers who quickly sensed its possibilities.

The inventor of the process discovered that coatings of many common metals such as lead, zinc, and aluminum could be applied permanently to properly prepared surfaces by spraying them with atomized particles of molten metal hurled forth by compressed air. In practice, a wire of the desired metal was fed into a spraying tool, melted immediately in front of the nozzle by an oxy-acetylene flame, and atomized and blown out by a powerful stream of air.

Containing in principle the basis of a revolutionary invention, this early ap-

paratus was found lacking in the essential commercial requirements of uniform operation and control.

Engineers here recognized both the potentialities and defects of this European equipment. For years, they experimented with the apparatus to the end of discovering the exact requirements for the perfect operation of a metal sprayer under all working conditions.

The resultant apparatus, based on their findings, was essentially the metal-spraying apparatus of today. Weighing only three and a half pounds, and capable of being precisely regulated to compensate for the differences in the melting points and thicknesses of wires of the various metals used, the new spraying gun is as easy to manipulate as a welding torch or a paint sprayer.

In the latest type of spraying gun, metal in the form of standard gage wire is automatically pulled from a reel by a compressed air turbine and passed uniformly, at a rate of twelve to twenty-four feet a minute, into an oxy-acetylene reducing flame. Immediately and continuously the tip of the wire is melted, atomized, and blown in a fine spray by air at a pressure of fifty pounds per square inch, onto the

surface to be coated. The tool may be so adjusted that the wire is passed into the flame at a rate exactly sufficient to absorb the heat units therein. A miniature cupola furnace, in other words, the melt and pour of which may be adjusted with watch-mechanism precision!

In use, the sprayer is passed across the surface to be coated at a uniform distance of about four inches. At that distance the spray covers an area slightly less than two inches in diameter, and a single pass deposits a coating about one-thousandths of an inch thick. The operator's vision easily guides him in distinguishing between the coated and uncoated portions and between the first and succeeding coats. By repeating the passes, coatings may be built up to any reasonable thickness—even heavy bars of solid metal may be produced.

On a properly prepared surface, generally roughened by sandblasting in the case of wood or metal, the coating becomes practically integral, has all the characteristics of metal cast by more ordinary means, and may be hammered, filed, polished, or otherwise finished, without loosening. Thousands of shells have been coated with zinc, copper, and lead, to correct imperfections (Continued on page 109)

Department of Agriculture experts are using the apparatus, right, to test the effect of small amounts of sulphur dioxide gas upon field plants, shrubs, trees, and weeds in a closed chamber. The amount of gas used is about the same as comes from the big factory smokestacks.



The coal held in the chemist's hand contains enough sulphur to tip the heads of six packages of matches. If the coal releases sulphur dioxide gas

Sulphur dioxide is a gas, right, that can be carried from place to place in a small glass jar. It will be released when the coal is burned. It will be

prove fatal both to plants and persons



P New Ways to Fight POISON FOG

POISON fog claimed the lives of sixty beggars two years ago. Now it may be banished forever, by two outstanding inventions reported to the American Chemical Society. One is a super-sensitive detector that warns when sulphur dioxide gas—the deadly element in poison fog—reaches a dangerous concentration in the air. The other, a process for making "sulphurless coal," would remove the source of the menace if applied commercially. It is the sulphur, found as an impurity in all kinds of coal, that produces sulphur dioxide gas when the coal is used as fuel in factories.

When a malignant vapor hung day after day over the Meuse Valley of Belgium and felled scores of men and hundreds of cattle, chemists rushed to the scene. They identified the phantom destroyer as sulphur dioxide gas belched from factory chimneys. The acid-forming gas, collecting on fog particles floating in the air, seared the lungs of those who breathed it.

Exterior heavy weather conditions helped the Belgian fog—cold lower air and absence of wind. Such a condition might recur only once in every year. Even in lower concentrations, however, sulphur dioxide gas from factory smokestacks constantly imperils the health of city dwellers, attacks steel and masonry structures, and reduces the yield of crop plants.

Hence two U. S. Department of Agriculture chemists, S. W. Griffin and W. W. Skinner, have just perfected a portable



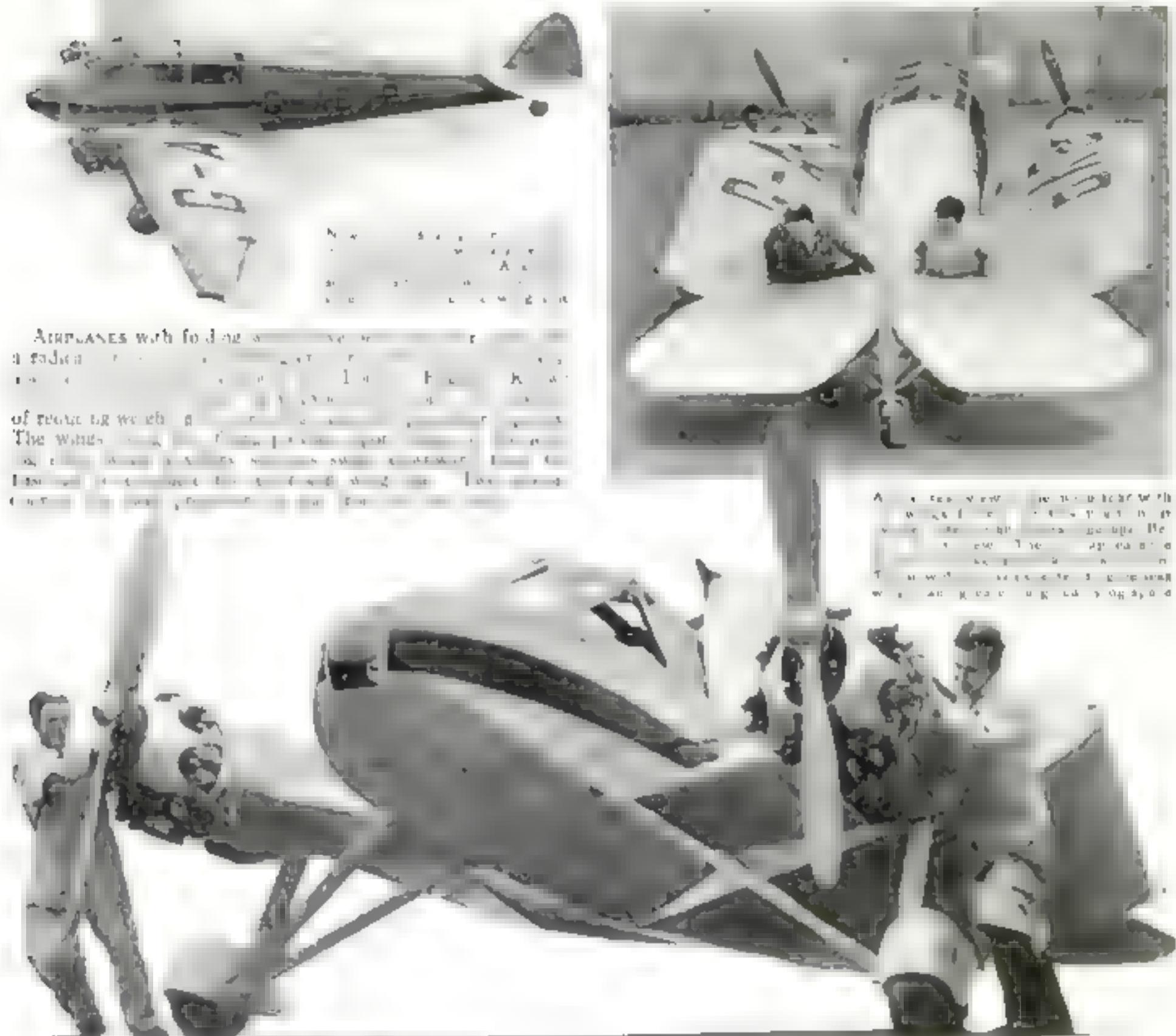
detector that may be set up anywhere to measure traces of sulphur dioxide in the atmosphere. It can detect one part in fifty million parts of air, using a chemical reaction in which a solution of common iodine is the reagent. If much gas is found in the air, inhabitants may be warned.

Meanwhile Dr. Robert D. Snodgrass, of the University of Illinois, announces a method to rid coal of sulphur. On a laboratory scale, he has succeeded in eliminating as much as ninety-three percent of the sulphur. The coal is ground to powder, boiled twenty-four hours in acidified ferric sulphate solution (a salt of iron), then kept at a high temperature for four hours while a stream of hydrogen gas passes over it.



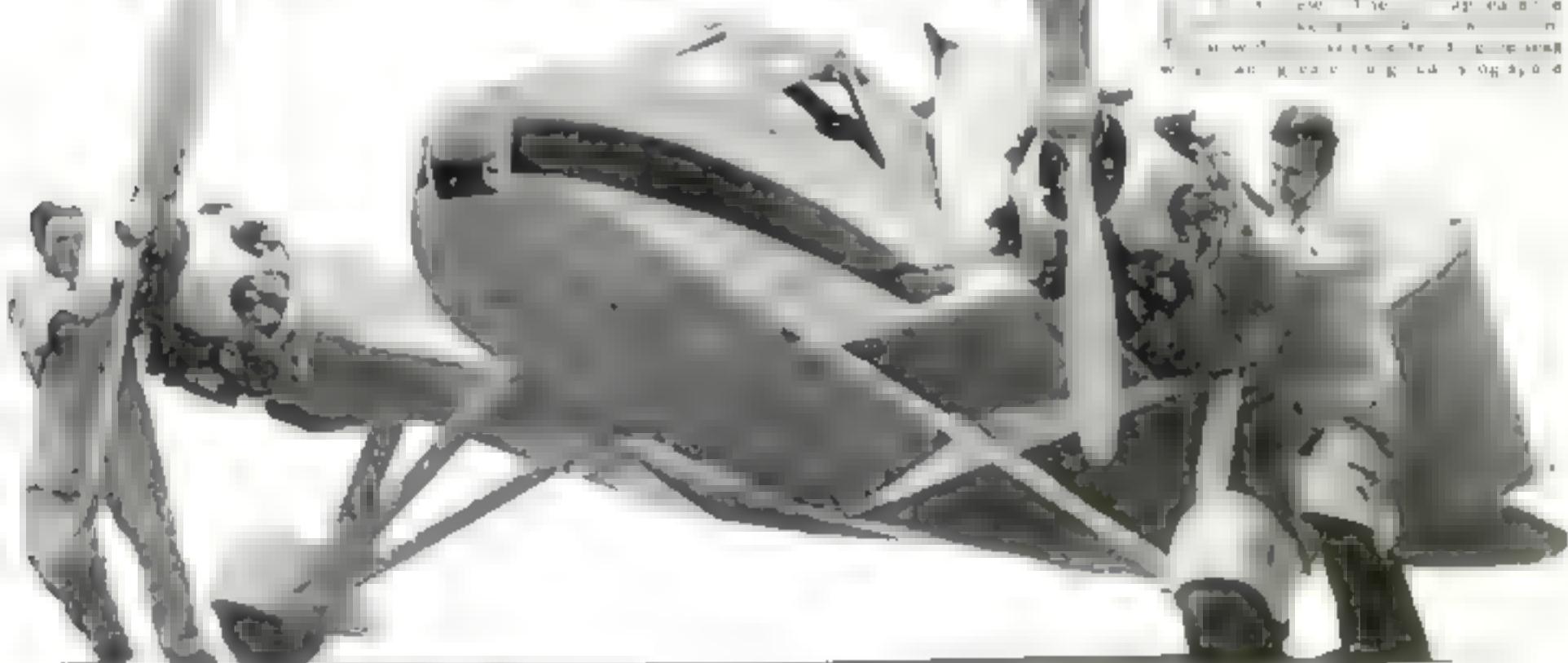
How Sulphurless Coal Is Made in Laboratory

New British Plane Has Hinged Wings



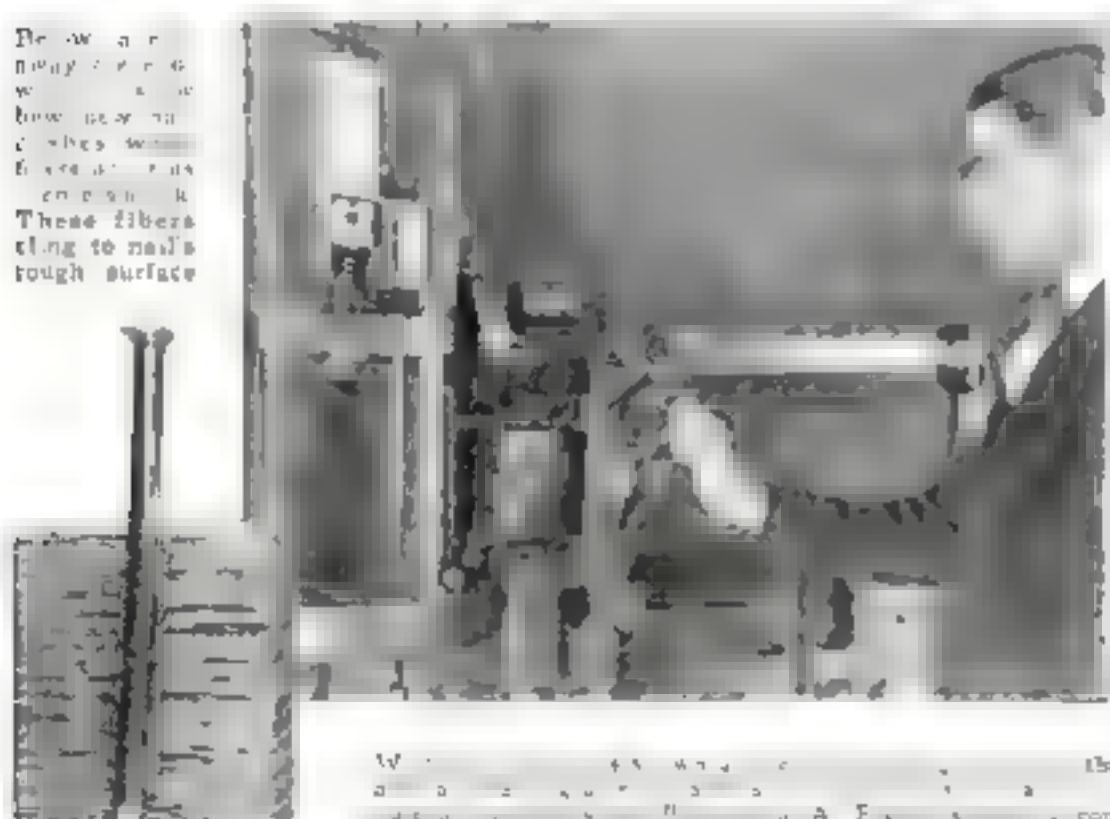
AIRPLANES with folding wings folded.

The wings of the new British biplane can be folded back so easily that the plane can be transported in a truck. The weight of the plane is reduced by about 100 pounds when the wings are folded. The folding is done by a simple mechanical device which is attached to the wings.



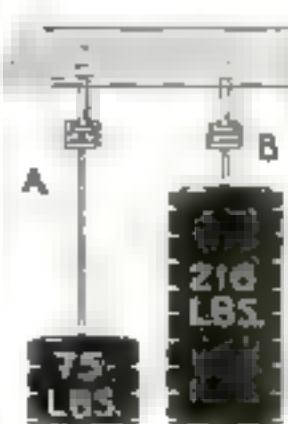
NAILS, WITH ROUGH SURFACE, HAVE GREAT HOLDING POWER

Below are many drawings showing how new nails cling to wood. These fibers cling to nail's tough surface.

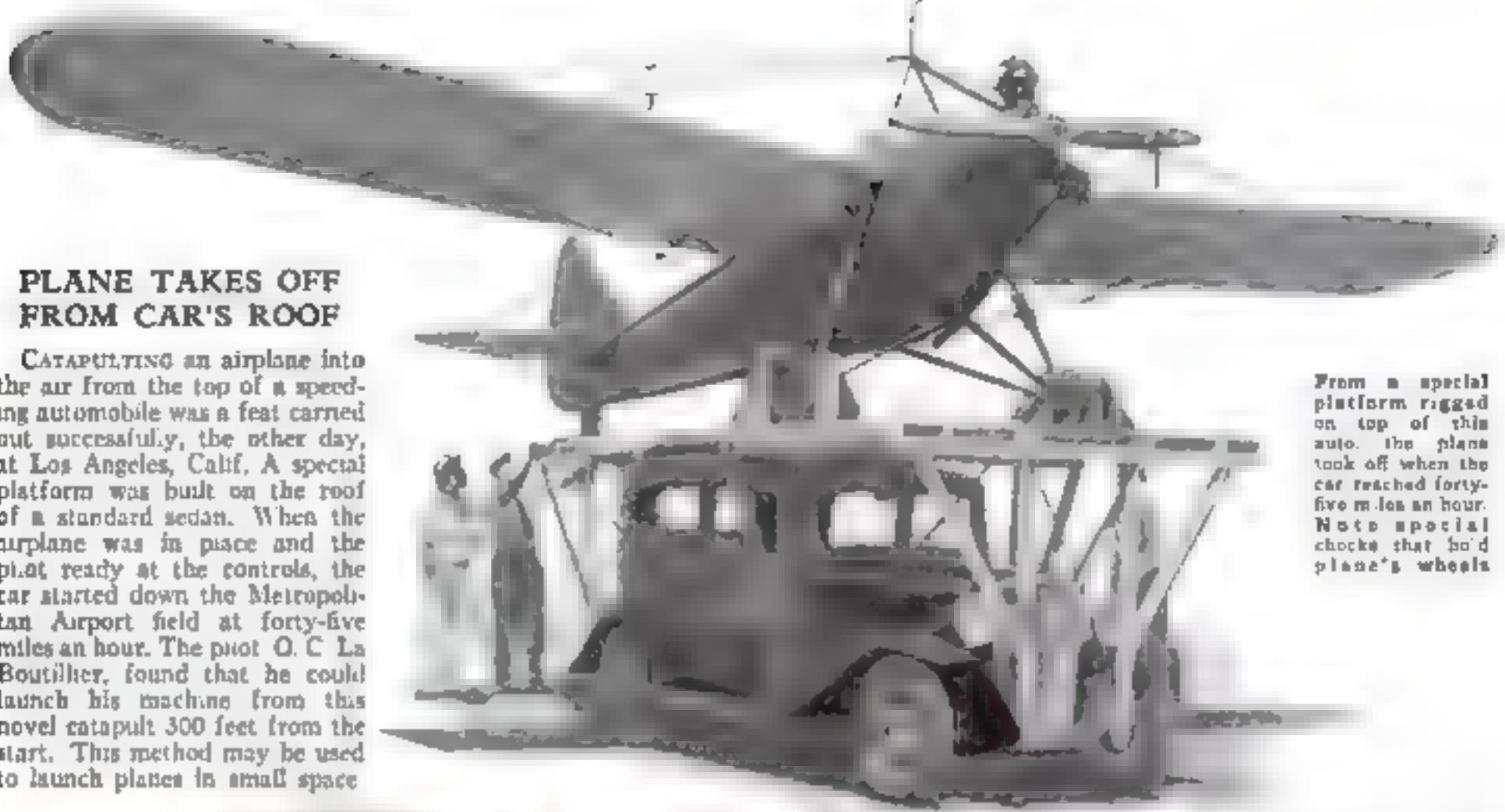


A new nail with nearly three times the holding power of an ordinary one has been developed at the U. S. Forest Products Laboratory, Madison, Wis. The secret of its increased efficiency is a roughened surface barely noticeable to the eye, which enables wood fibers, into which it is driven, to cling to it more tenaciously. This surface is produced by etching the nails in an acetic acid solution of ferric and mercuric chlorides. When tested at the Wisconsin laboratory with a special nail-pulling apparatus that records, to the minute fraction of a pound, the force exerted, the new nails required a pull of 216 pounds to extract them. Common nails of the same size, driven into the same piece of wood, pulled out at seventy-five pounds.

Since the fibers cling tightly to the new nails, the decay of the wood around them is expected to be unusually slow.



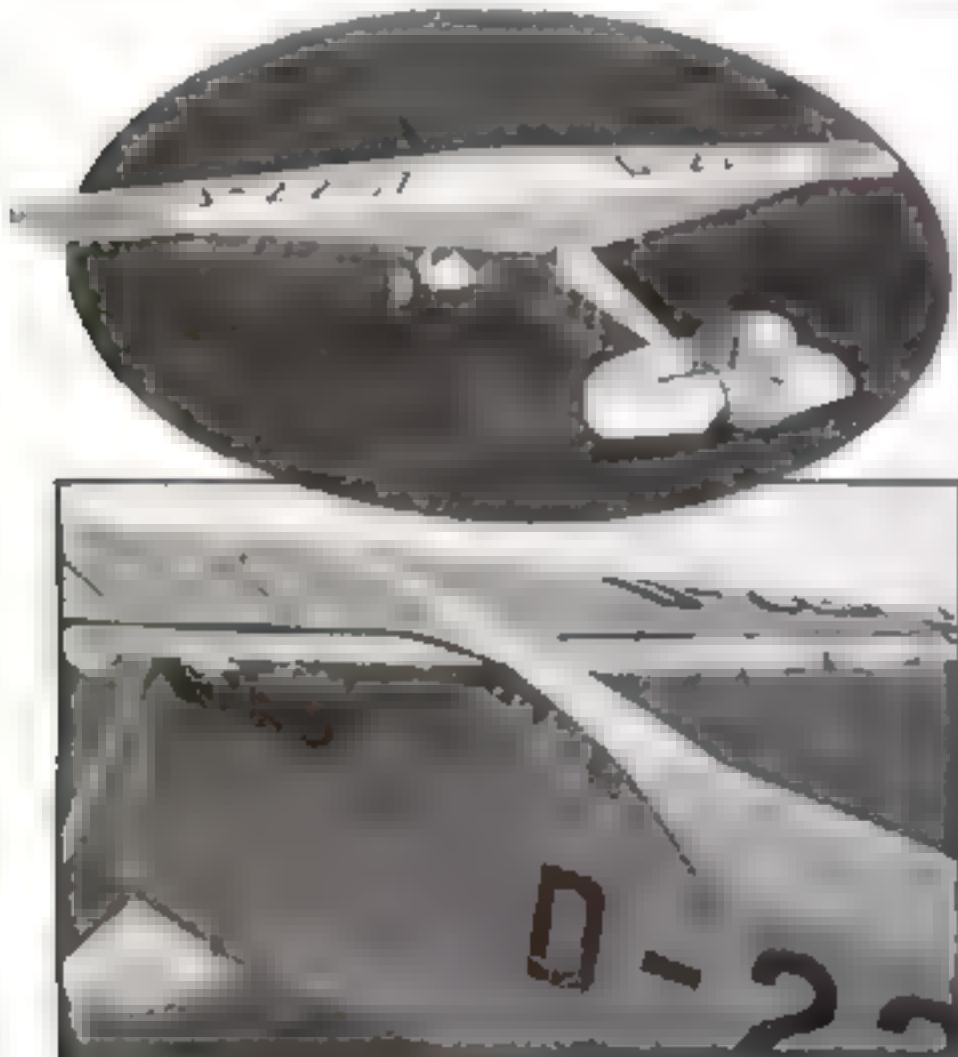
The new nail was tested in force, at B, was recorded for this difference.



PLANE TAKES OFF FROM CAR'S ROOF

CATAPULTING an airplane into the air from the top of a speeding automobile was a feat carried out successfully, the other day, at Los Angeles, Calif. A special platform was built on the roof of a standard sedan. When the airplane was in place and the pilot ready at the controls, the car started down the Metropolitan Airport field at forty-five miles an hour. The pilot O. C. La Boutilier, found that he could launch his machine from this novel catapult 300 feet from the start. This method may be used to launch planes in small space.

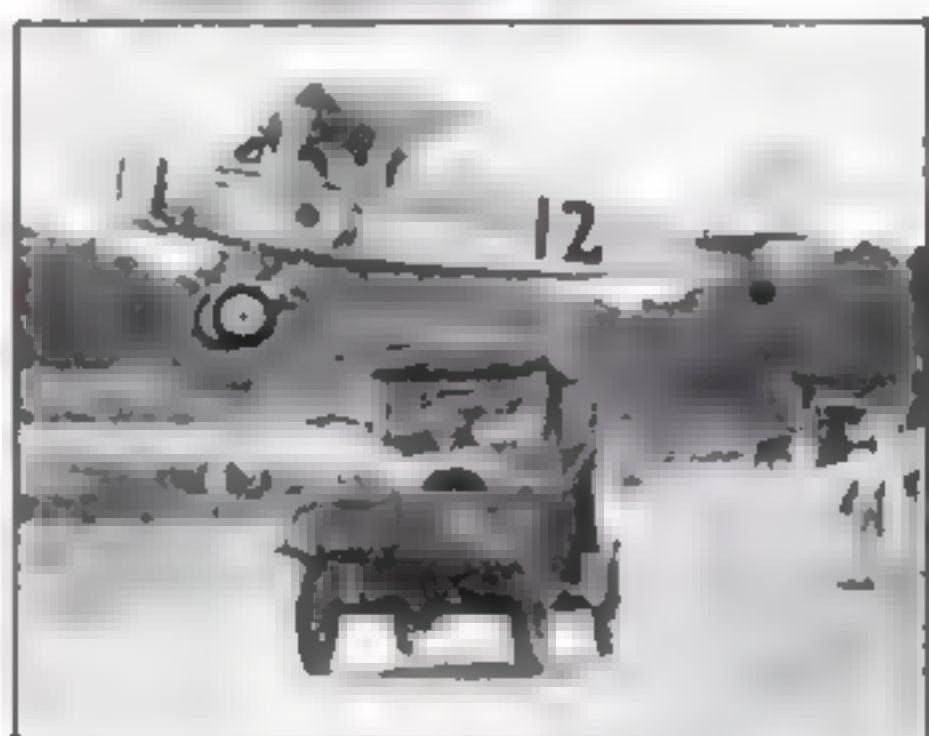
From a special platform rigged on top of this auto, the plane took off when the car reached forty-five miles an hour. Note special chocks that hold plane's wheels.



In top, expanding wing plane with fins extended to give increased wing surface. Above, close-up of plane showing slots into which the fins fold.

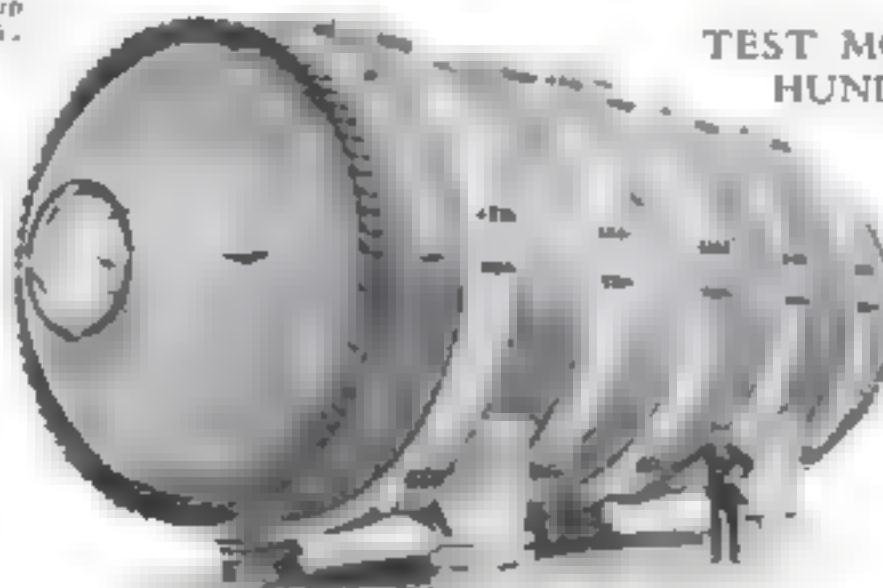
PLANE, WITH EXPANDING WINGS, FLIES IN TEST

A NEW type of airplane with expanding wings was recently flown in Germany. Supplementary wing surfaces or fins, one on each side of the fuselage, fold into slots in the main wing or slide outward between guiding rollers to increase the area of wing surface. The pilot may alter the size of the wings while in flight in accordance with his altitude and speed to secure the maximum lifting efficiency. Controls for this purpose are mounted within his cockpit.



FLYER MISSES TRUCK BY INCHES

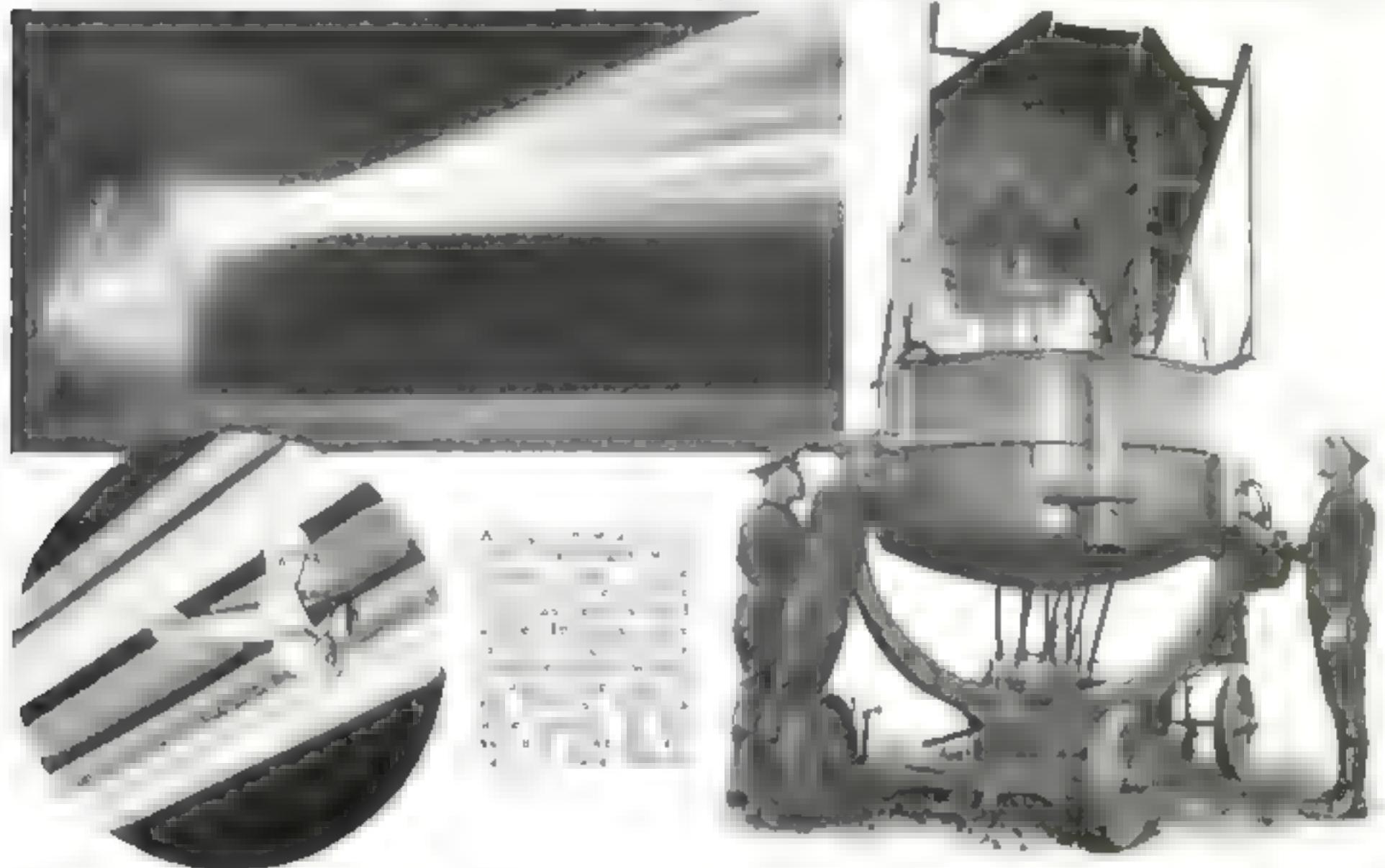
No wonder the driver of the truck, in the picture above, put out his hand and slammed on the brakes. A fast plane roared down out of the sky and missed him by inches. The close shave occurred near a Washington airport when a contestant in a transcontinental race was practicing landings. Bystanders tried to stop the truck driver, but he missed seeing their signal. A cameraman was successful in recording this strange traffic hazard.



TEST MODEL PLANES IN HUNDRED-MILE GALE

HUNDRED-mile-an-hour gales rush through a 400-foot steel and reinforced-concrete wind tunnel recently completed at the Farnborough testing field, in England, and illustrated at the left. A 2,000-horsepower engine creates the artificial hurricane within the tube where models are tested.

Anti-Aircraft Searchlight Casts Nine Beams

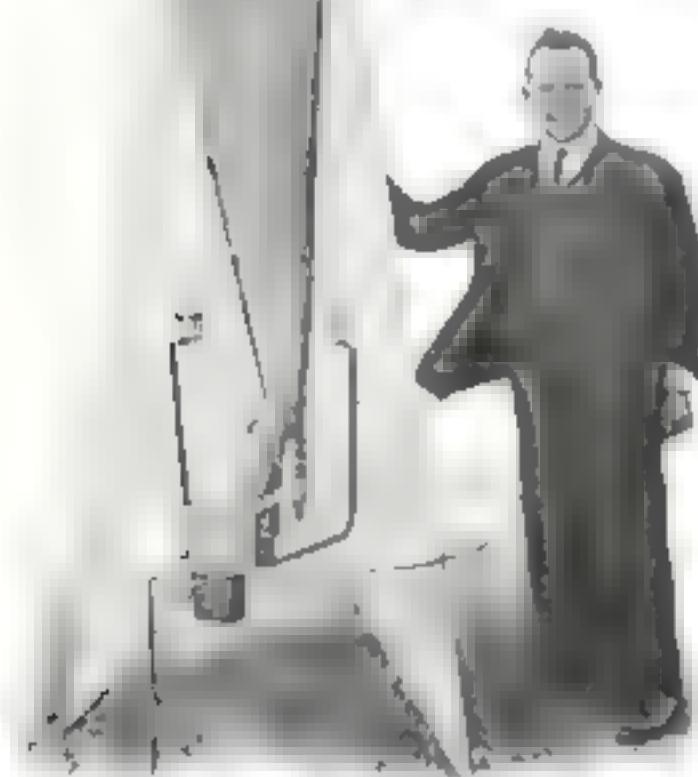


MILITARY officials at Fort Totten, N. Y., recently witnessed a demonstration of a really new type of anti-aircraft searchlight. Hostile aircraft could hardly escape from its rays since the main shaft of light is split into nine or more separate high-

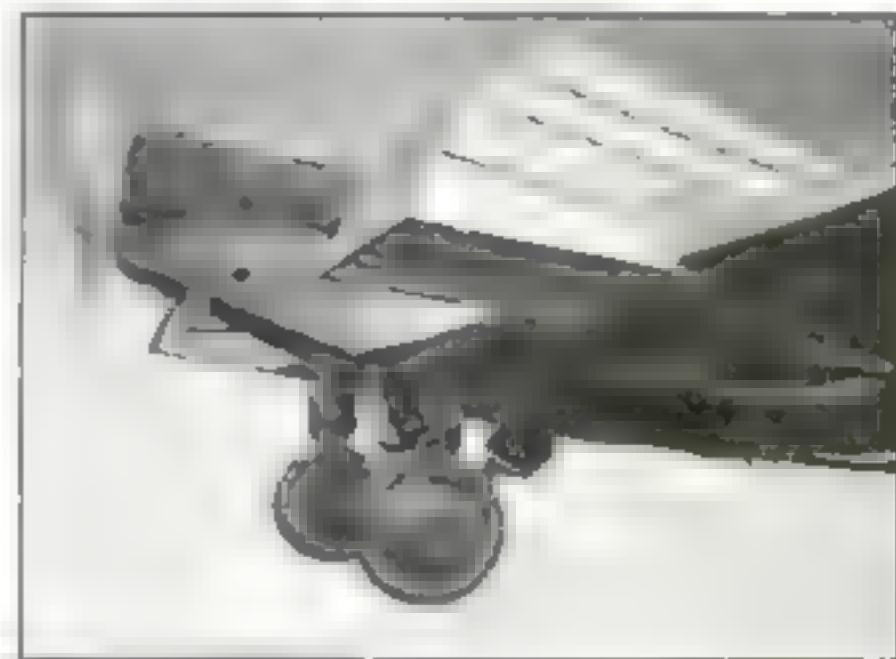
intensity beams. This is accomplished by mounting a set of mirrors at an angle just in front of the searchlight. Each mirror rests at an angle slightly different from the others and casts a separate beam. Capt. A. M. Jackson, of the 62nd Coast Artillery, who invented the searchlight, has perfected the angles mathematically so no beam interferes with the rest. The searchlight employs a light source with an intensity of 800,000,000 candlepower. Gases and heat are removed with blowers.

TO TEST HIGH FLYING ROCKET

STREAMLINED like an airplane body, a rocket is shown here by its inventor, Robert W. Strode, of the Research Department of the Goodyear Tire & Rubber Co. The rocket is designed to test the effects of high flying on rubber.



Streamlined rocket for high-flying experiment



VOICE FROM PLANE HEARD FOR MILES

Loudspeakers often have to be fitted to a plane's exterior to provide clear communication between the pilot and the ground. One of the most effective ways to do this is to make the speaker cabinet aerodynamically shaped. It is built in the shape of a bullet, so the sound may be heard for miles.

MOTOR DRIVEN PLANE FLIES AROUND POST

To amuse his small son, Fred E. Engler, of Pukwana, S. D., built a toy airplane that actually flies—or so it seems to its youthful rider. The model plane has a propeller that really runs, under the power of a small gasoline motor. It is hung like a swing, on cables, from a homemade standard. The supporting arm is a bar free to revolve. When the young pilot boards the machine and opens the throttle, the plane flies around and around the post at surprising speed. Thus the youngster gets all the thrills of flying with never a fear of a nose-dive or crack-up. Engler, as a spare-time hobby, has built several model airplanes, and powered them with gasoline motors so they fly short distances.



Fastened to the swinging arm of an upright, this small plane is driven by a motor at surprising speed around the post while piloted by a boy

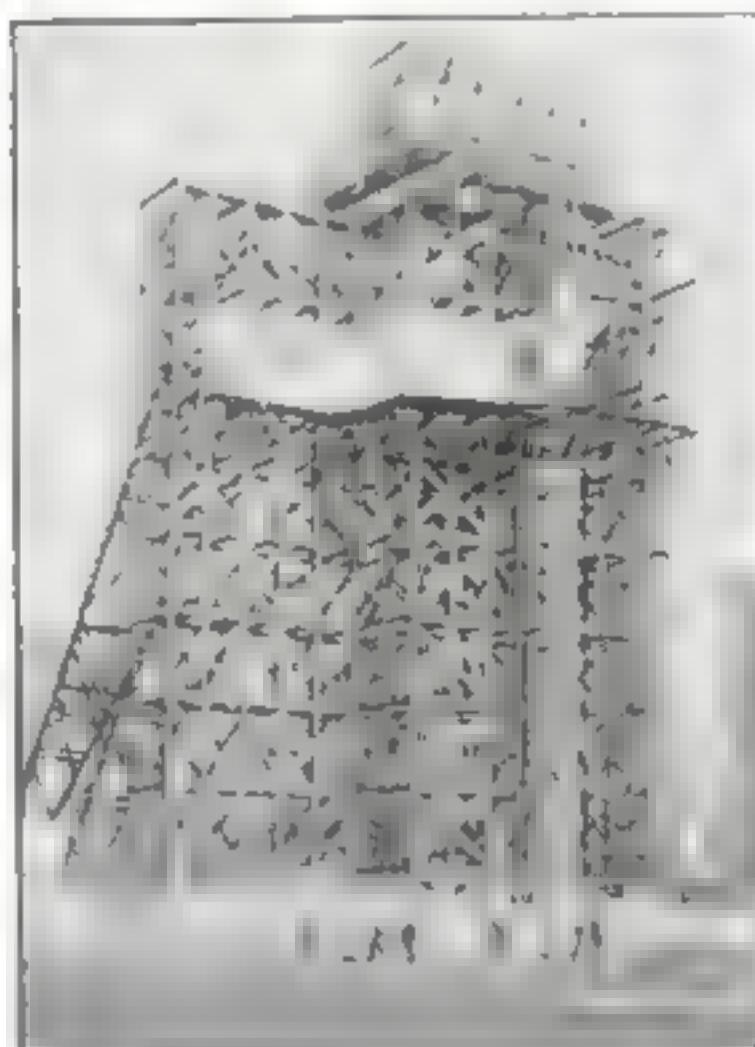


AUTO ROADS OF GLASS

Most motorists will swerve to avoid a bit of glass lying in the road—but whole roads of glass are proposed by George J. Ricketts of London, England. According to his plan, interlocking "bricks" of glass would provide a smooth surface easily kept in good repair. Exposed faces of the bricks would be ribbed in a non-skid pattern. The photograph above shows the originator of the glass-road proposal, with two types of glass bricks.

PLASTER MODEL HELPS DESIGN BUILDING

WHEN the Franklin Institute in Philadelphia recently contracted for a new building to serve as its home, officials of the Institute and the city's Art Jury wanted to see in advance what the exterior would look like. So the contractor erected a wooden scaffold on the building site and displayed models in plaster of the building sections, at the height they would appear in the finished structure. Thus the future owners were able to be sure the finished building would be an artistic credit to the neighborhood.



Mounted on a scaffold, this plaster model showed how a section of a proposed building would look when finished.



With this sacred pointer, an ancient South Sea navigating instrument, a modern ship was guided across Pacific

EACH KEY HANDY IN THIS CASE

PULLING down a metal tab on a new key case brings all the keys out at the bottom, ready for use. An opposite motion withdraws them until further need. Held compactly and conveniently, they occupy little space in the pocket and cannot damage the lining of clothing while each key is in such a position that it easily can be used.



Tunnel Pierces New Airship



Through the center of this new dirigible runs a tunnel to reduce wind resistance.

TALL CHIMNEY FALLS IN PERFECT BOW

WHEN a chimney of an abandoned German gas works was razed, not long ago, it made an unusual picture as it fell. Instead of breaking into two or three pieces as might have been expected, the stack bent and dropped to earth as a unit. A photograph snapped at the moment of toppling showed it as a perfect bow. A moment after the picture was taken, the fragments struck the earth with a deafening crash.



TYPICAL AMERICAN IS NO ADONIS



Typical American, modeled from 100,000 measurements of war veterans.

WHAT does the "average American" look like? To find out, a statue was recently modeled from the composite measurements of 100,000 U. S. war veterans, and exhibited in New York to an international meeting of experts in eugenics. It bears little resemblance to the Adonis of classical mythology, as portrayed by sculptors. The modern male is slight of build, with more development of his abdomen than of his shoulders. However, experts agree that this type of physique adapts him most perfectly to conditions of modern life.

A THIRTY-THREE-FOOT model of a new style of dirigible was demonstrated at Van Nuys, Calif., the other day. An open tunnel pierces the entire length of the gas bag from bow to stern. The inventor, Thad Rose, believes that this will reduce wind resistance and increase the speed of the ship in flight. Two small electric motors ran the model airship's tiny propellers in the successful trial flights.

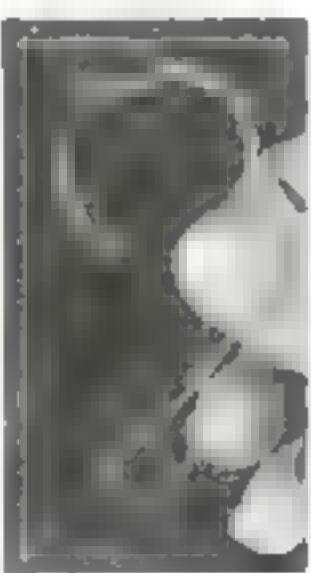


TINY RADIO SET WILL FIT IN POCKET

Now a pedestrian may tune in on his favorite radio program while he strolls down the street. A pocket receiving set, exhibited at a recent English radio show, is so small that receiver and batteries may be carried in the pocket. The loudspeaker is contained in a hat. Possibilities of the novel set are not restricted to entertainment, for a special adaptation of it is reported in use by British police in receiving reports from a central station.

NO BARB ON FISH HOOK

A BARBLESS fish hook just patented by a Johnstown, Pa., cabinetmaker, allows undersize fish to be removed and returned to the water without injury. Its spring grip resembles that of a safety pin. Caught in clothing, it is readily removed, and it is said not to snag easily in weeds or overhanging branches.



• New Art Fits Foreign

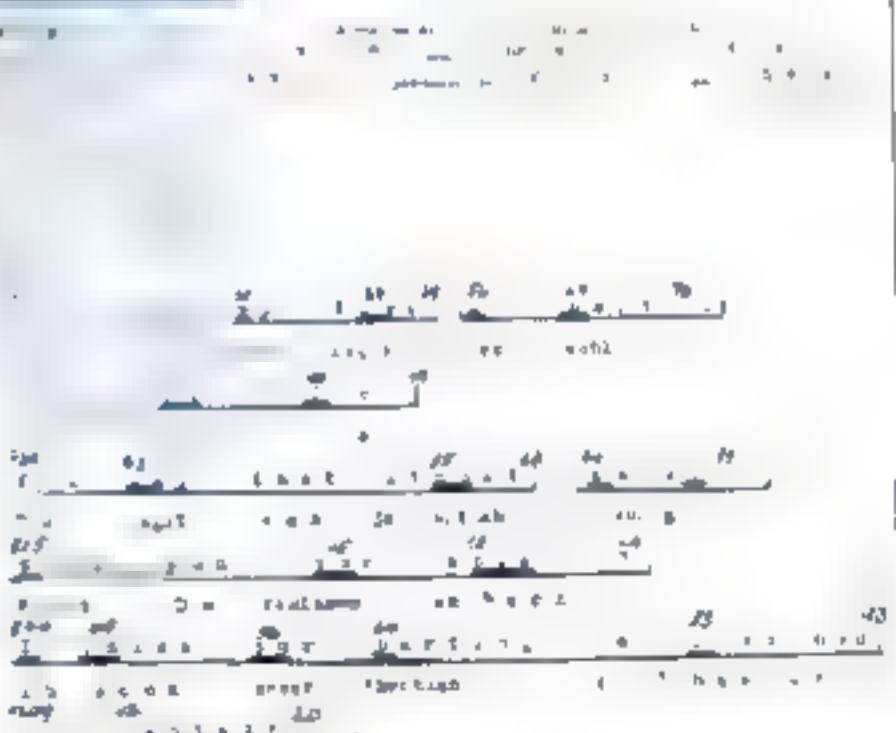


LIP MOVEMENT MARKED After the original dialogue has been translated, the director with translation in hand, slowly runs off the film, noting places where lip movements must be treated and underlining the script for the actor.

TRANSLATING ORIGINAL WORDS. Beneath the dialogue of the original right is written the translation. In this case from English to German. Note numbers above words, indicating a "frame" of the fact, also that each version has same number of syllables.

PITTING ON A NEW LANGUAGE

In these cities, trained linguists speak the language of a tongue. Each actor is guided by a revolving disk marked so as to insure synchronization of sound and action and the right movement of the eyes to fit the original picture.



Speech to Any Film



Talkies' Hardest Problem Solved by a Most Remarkable Process That Easily Replaces One Language with Another

LANGUAGES are being fitted like garments to actors in the talkies, these days so that motion picture producers may send their films to foreign countries. An American moviegoer may enter a Paris or a Berlin theater and find his favorite actor proposing to the leading lady in French, or discussing a business deal in German. A foreigner is likely to hear a star of his homeland perform in English on an American screen.

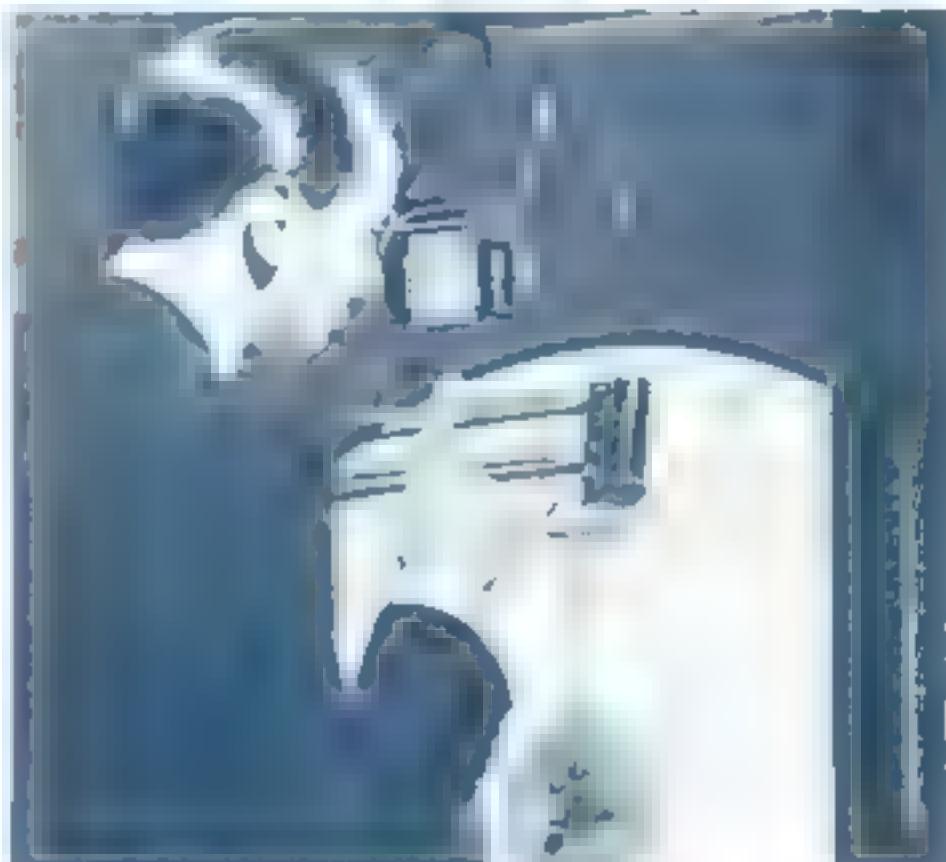
This does not mean that the popular idols of the screen have suddenly acquired such mastery of foreign tongues that they can act in any language. Even if they could, the cost of filming so many versions would be prohibitive. Actually the dialogue that apparently comes so glibly from the actors has first been spoken by unseen "doubles."

Pictures on this and the preceding page, made in a German studio, show exactly how the process is carried out. First each "frame," or picture, in a film is numbered consecutively. Then an expert copies down the dialogue, noting against each word the number of the "frame" where it occurs. Next the text is translated. Syllables whose pronunciation requires distinct lip movements are underlined, for the translator in the foreign version must use equivalent words that are spoken with approximately the same movements. The completed translation is transferred to a disk that rotates before the actor-linguist and tells him when to speak each word. Rehearsals follow until all the "doubles" are ready to re-enact the dialogue together on sound film. When this sound record is combined with a silent copy of the original film, the foreign version is complete.

When talkies came into style, it seemed at first an impossible task to change the whole dialogue for foreign presentation. Movie technicians, however, have conquered movie talkie's most difficult problem.

TRANSLATING TRANSLATION At left, a film reel containing the original dialogue is numbered frame by frame. The numbers are copied onto a card.

A REVOLVING DISK showing being used to translate the words.



REHEARSAL COMES FIRST To be sure they will speak the right words throughly the actors stand in front of the disks and rehearse their parts as the translated phrases appear before them.

WHEN SOUND CAMERA WORKS At left a view of an actor speaking the translated dialogue as disk, with pointer of light picking out the syllables, revolves slowly in front of him. This is the final step in putting a new language on the film without remaking the entire picture.

TRICKS You Can

LEARNING A BACK FLIP-FLOP

This trick is taught by lifting the dog with the chain attached to his collar while with the stick, his hind legs are tapped into the air. In photo the dog's feet are just leaving the ground.



TURNING A SOMERSAULT

In teaching a dog this trick, you must hold his head down with one hand, lift the body up and over with the other, at the same time giving the command, "Turn over." Food is given as a reward for good work.



YOU can easily teach your pet dog tricks, according to the veteran showman, Henry B. Gentry, who has developed some of the most famous trained dogs in the country.

The first thing to do is to let the dog you intend to train live his own life for a year. Dogs less than a year old are too full of puppy ideas to take instruction seriously.

When he has reached the required age teach him first of all to sit up. Do this by setting him on the ground, taking hold of his front feet and lifting him to a sitting position, at the same time tapping him gently beneath the chin with your finger and saying "sit up." Instead of snapping with the finger, you can tap him gently with a stick. The idea is not to hurt or scare him, but to persuade him to keep his head up. Some dogs will sit up at the command after being shown a dozen or so times. Others require much longer. The essential thing on your part is to be patient.

The second-grade stage consists of instruction in standing up. Put a collar on your pupil and attach a rope or chain. Then lift him until he is standing upright on his hind feet. At the same time tap his front feet with a stick, just hard enough for him to feel it. Don't be afraid of injuring him by lifting with the collar, for there is no danger of choking if you do it carefully. This trick is a little more difficult than sitting up, as a dog finds it harder to balance himself on his hind legs alone, but he will soon master it.

WALKING WITH WRONG END UP

To teach a dog to walk on his front legs, the head is held down with one hand and the hind quarters are caused to walk. Only patient repetition will put

The simple somersault may be taken as the next logical step in your dog's education. It is not easy because a dog objects to holding his head down. So you must put him through the routine over and over by hand. With one hand hold his head to the ground while with the other you lift his body up and over, at the same time teaching him some such command as "turn over."

Next you may as well take up the back somersault which is performed in the air—really a backward leap. Loop the dog with a collar and rope and obtain a stick. A thirty-six-inch length of dowel rod is excellent. Put the stick under the dog's front legs, lifting upward on it and at



STANDING ERECT LIKE A MAN

Learning to stand or walk on its hind legs is best to sitting up, the easiest trick you can teach your dog. With a rope fastened to the collar the dog is lifted erect and the front feet are tapped to keep it standing up.

Teach Your DOG

*Veteran Trainer Describes Stunts
Your Pet Can Easily Acquire—if
You Use Enough Patience and Time*

By WALTER E. BURTON



the same time jerking the dog up and over with the cord. This may sound a bit rough on the pup, but circus trainers have not found it so. This trick is the hardest one so far, but is particularly effective when performed.

Walking on the front feet is, for a dog, not easy. Place your training stick under his hind legs and lift him to a vertical position, at the same time holding his head down with your other hand. Then keep him upon his front feet by tapping his hind legs with the stick, hard enough for him to feel it.

THE jumping rope trick is a good one to show visitors. Arrange a rope that can be whirled around, and put a collar and cord on the dog. Then place the dog over the rope, start turning it, and lift him up by the collar each time it comes around. At first, the dog will move sidewise in an attempt to get out of the way of the rope; but soon he will learn to jump upwards. Instead of a whirling rope, you can use a stick, swinging it around in a circle for the dog to jump over.

There is another rope trick that may be regarded as a post-graduate stunt. In performing it, the dog climbs on a slack



rope and then stands upright on his hind feet. A rope an inch or more in diameter is used. First teach the dog to stand upright on the ground. Then put him on the rope and work with him until he can balance himself on all four feet. Next coach him in standing on his two rear feet only, a stage made easier by his knowledge of how to stand upright on the ground.

There are, of course, countless other tricks that your dog can be taught. But this collection will be found adequate for the average canine performer.

There is one important thing that no dog trainer overlooks. That is the reward. A generous allowance of hamburger or a dog biscuit at the conclusion of each lesson or after the successful performance of a stunt will go a long way towards assuring success. Circus dogs are liberally rewarded while being trained, but are not paid during an exhibition as that would lower the effectiveness of the acts from the viewpoint of the spectator.

Probably you have noticed that dog trainers at the circus always carry whips.

In making as many as forty energetic dogs cooperate in giving a performance, the whips are needed to keep the performers from fighting or clustering around the director and spoiling the act. However, the dog lover who is attempting to teach his solitary pooch a few choice stunts will find no need for a whip and probably will get along better without it.

A TRAINED dog's active life is usually from ten to twelve years. Among circus men, the favorite performing dogs are fox terriers and collies. The spitz, the greyhound, and one or two other breeds are comparatively easy to train and monkeys sometimes make star performers. Poodles are very much in evidence in circus dog troupes, even though most members of the poodle family are bone-heads when it comes to learning tricks. However, when a poodle can be taught, he makes an excellent actor.

It is difficult to understand why more dog owners and dog raisers do not spend a few minutes each day teaching tricks to their pets. In addition to knowing how to perform his collection of tricks, an educated dog does everything else more intelligently, and his cash value is much higher. A well-trained circus dog is worth his weight in gold and a troupe of dogs, trained to cooperate in their performance at their master's command, is priceless.

RADIO and DYNAMITE



Two million cycles
radio prospecting equipment.



HOW DEEPLY BURIED SALT DOME IS MEASURED
Diagram showing how trucks are placed and explosives detonated in order to discover the exact size and location of a salt dome which may lie thousands of feet beneath the earth's surface. By shooting a probe at the dome the prospectors find where the unseen field begins and ends

FORTUNES in zinc ore today are shipped to Europe from enormous deposits in Newfoundland where five years ago, not an ounce of ore was being mined.

For miles around, the territory including the now famous Buchans Mine belonged to the late Lord Northcliffe British newspaper publisher, who had bought the land for the sake of its paper supplies. One day, an Indian, fishing with a net in a river, hauled up a strange looking rock. It was zinc ore.

Northcliffe immediately called in his geologists whose tests showed the ore would be costly to work. The thin vein was estimated to contain about 100,000 tons. Northcliffe refused to get excited.

In 1927 another party of experts visited the region. Equipped with electrical prospecting instruments, they made a sensational discovery. Back from the river the country was covered deeply with dry gravel ages ago by a great glacier. This gravel bed, concealing two huge bodies of zinc ore contained nearly 600,000 tons.

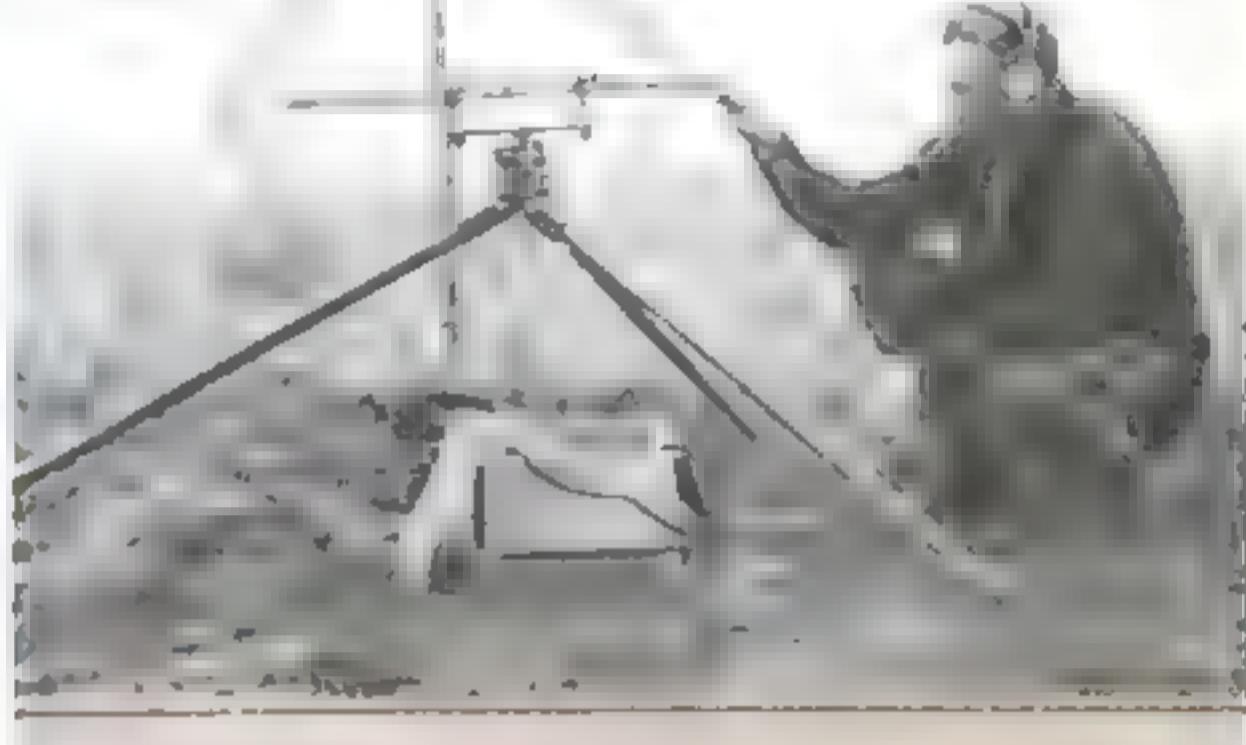
Lacking modern apparatus, the mine of riches might have gone unnoticed for generations. The second group of experts represented a new type of treasure hunter who, by the magic of the latest scientific methods, now makes the earth reveal its hidden wealth. They were successful because they resorted to the science of geophysics.

What the X-ray is to the physician, geophysics is to the prospector. It enables him to probe deeply into the earth without the dangers, toil, and expense of excavation. Delicate electrical machines, by measuring the strength with which electric currents flow through the earth, reveal conditions below the surface. Dry rock

find Earth's Secret Riches

*New Miracle-Working Machines Enable
Experts to "See" Deeply Buried Wealth*

By CHARLES A. FLYNN



A radio receiving loop is part of the modern prospector's equipment. It is set at right angles to source of heat and if no sound reaches it, the waves have been deflected, probably by an oil field lying thousands of feet below the earth's surface.

offers great resistance to the flow of electrical current while many metallic ores, being highly conductive, show only slight resistance. Through these variations, trained men ascertain the presence or absence of minerals.

That was the process used in Newfoundland. Only recently, a Norwegian mining engineer made the startling announcement that, by the same means, he had located gold in northern Scandinavia where no gold was known to exist.

This so-called electrical resistance method is only one of many items in the amazing bag of tricks the geophysical prospector brings into play to discover mineral wealth. Instead of electrical currents, he may use radio waves to detect metallic ores, including gold and silver. A compass needle will find magnetic iron and oil-bearing rock. Remaining on the surface, he weighs the lower layers of the earth's crust with the "torsion balance," a bulky but delicate instrument that measures the increased pull of gravity in the vicinity of heavy ores and oil-bearing rock, thus determining the presence of such deposits.

The spinthariscope (P.S.M., April, '32, p. 124) tells him whether ores contain the world's most precious substance, radium. By means of a process resembling, in principle, that of the sonic depth finder which seamen use to measure the ocean's depth, he causes "elastic" sound waves to travel thousands of feet into the earth and to bounce back, revealing the presence of deep-lying fields of oil.

For the same purpose he more often adopts the "seismic" method of prospecting which, as the name implies, involves creating artificial earthquakes by the discharge of dynamite. The extent to which this work is carried on in this country

is indicated by the fact that 3,000,000 pounds of dynamite are being used annually in seismographic explorations in three of the great oil basins in the United States.

Reduced to its simplest terms, the method consists in staging a race between a radio wave and a shock, or seismic wave. This is the way it is done:

A charge of dynamite, sometimes as large as 500 pounds, is buried in the ground. Around the explosive is wrapped one wire of the antenna of a portable radio transmitter that sends out a sustained note. From two to five miles away, there are three trucks, spread out fan-shape, equipped with sensitive recording instruments. One of these is a special radio receiving set that casts a spotlight ray on a moving film as long as the broadcast sound comes in. The instant the dynamite explodes, breaking the antenna wire, the radio signal cuts off and the line on the film comes to an abrupt end.

Below this line is another formed by the reflected beam from a seismograph's mirror. It is straight until the shock of the explosion, running through the ground, reaches the truck and jolts the mirror, thus producing a jagged line. The film is divided by vertical lines into spaces representing hundredths of an inch. The number of spaces from the end of the radio-produced line to the beginning of the jagged line, indicates the exact time between the explosion and the arrival of the tremors. As the distance traveled is known, the rate of speed is easily computed.

Through ordinary earth, a ground tremor passes at the rate of about 6,000 feet a second, but through domes of salt which, in oil field regions indicate the presence of oil, it speeds up to about 16,000 feet a second. If the record made by one of

This graphic drawing shows how sound travels from explosion point and is reflected from the various strata of the earth's crust to instruments in the truck. White line shows break at points where tremors shook the seismograph.

the trucks shows the tremor came at a speed greater than 6,000 feet a second, the investigators suspect the presence of a salt dome somewhere along the line. To make sure, they begin "closing in!"

The first step is known as "cross-fanning." On one side of the line the trucks are spread out again in a fan shape while a charge of dynamite is set off a mile or so on the other side. If one truck gets the tremors in advance of the others, a line between this listening post and the blast is drawn on the map. Where this line bisects the first one is the position of the dome.

Before drilling begins, a final test, called "shooting a profile," is made. On a straight line between the dome and the dynamite, the trucks are placed in a row and then moved along across the dome making records of successive blasts. These records break up the territory where the dome is located into small sections and give the speed of the tremors through the earth in each. Thus, the investigators can determine just where the dome begins and ends. Also, by proving the tremor-speed is 16,000 feet a second exactly that found in rock salt, they know absolutely the formation below their feet is a salt dome and

Prospectors bury dynamite sticks and detonate them with an electric key in mapping strata of the earth's crust

that it is quite likely they have struck oil.

A successful device for locating oil wells is a metal "ear," the invention of Frank Rieber, Los Angeles, Calif., physicist, who has sought and found oil in many fields in the western and southern parts of the United States. Weighing

ninety pounds, the amazing apparatus is so sensitive that, buried under three feet of ground, it can "hear" the vibrations caused by two blades of grass slapping together 200 feet away! Because it measures directly the speed of waves traveling through the ground when dynamite is discharged, the "ear" takes the place of the seismograph. With it, Rieber often has heard "elastic" waves from dynamite explosions bump against the hard roof covering oil-bearing rocks, and bounce back to the surface.

The ear consists of a cylinder ten inches in diameter, containing a solid iron mass balanced nicely upon a single quartz crystal, which rests on the bottom of the cylinder and thus, in effect, on the earth when the instrument is buried. When an explosion sends its wave train bursting toward the ear the wave squeezes the crystal against the iron mass, creating at that instant the so-called piezo-electric effect, which generates a tiny electrical current. This is used to record, on photographic film, the time of the arrival of the wave, from which its speed is computed with ease and accuracy.

To prevent the ear from receiving and recording *(Continued on page 112)*

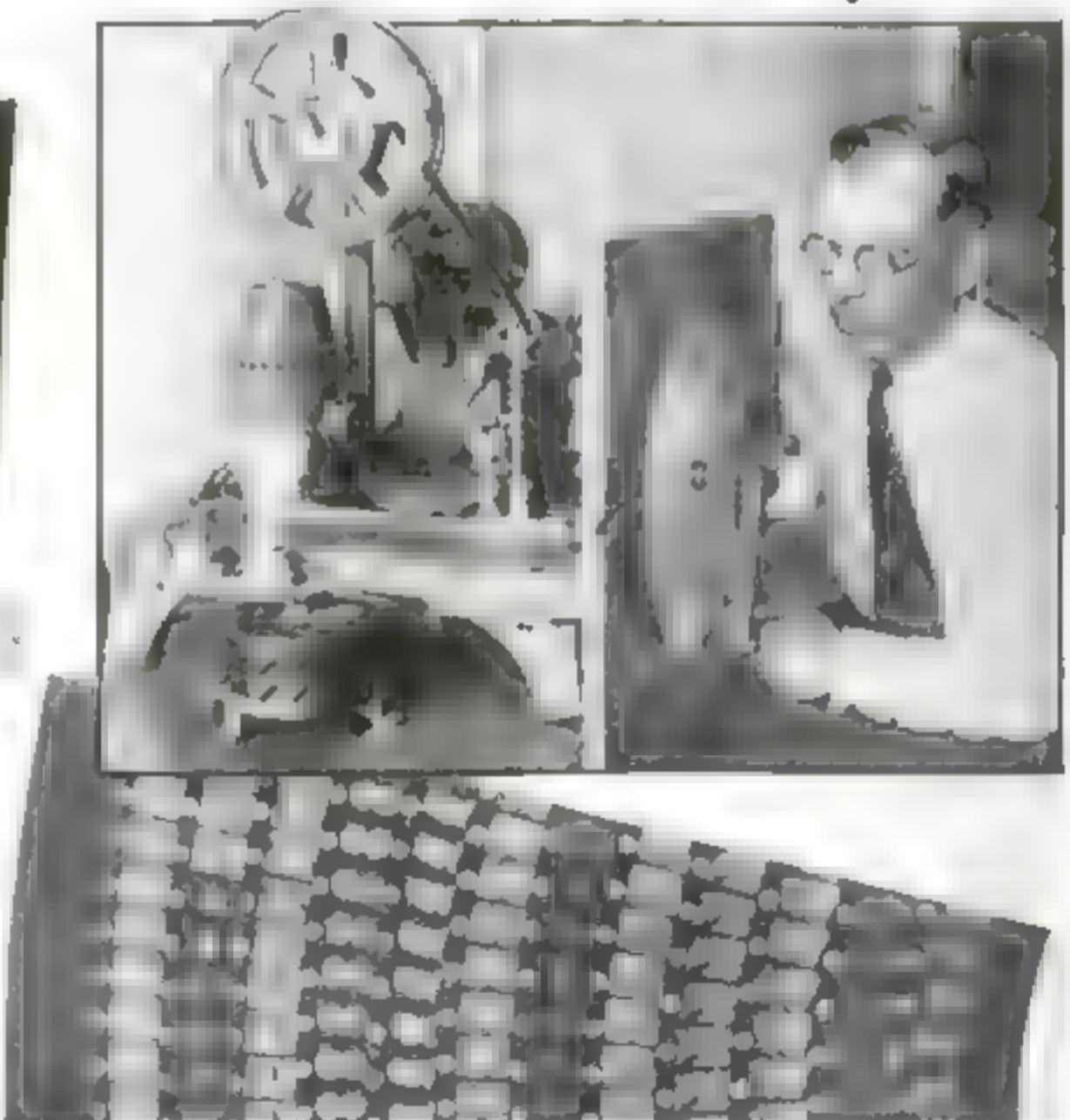
Disk Replaces Movie Film in New Projector



From film to this circular disk projection by a new machine

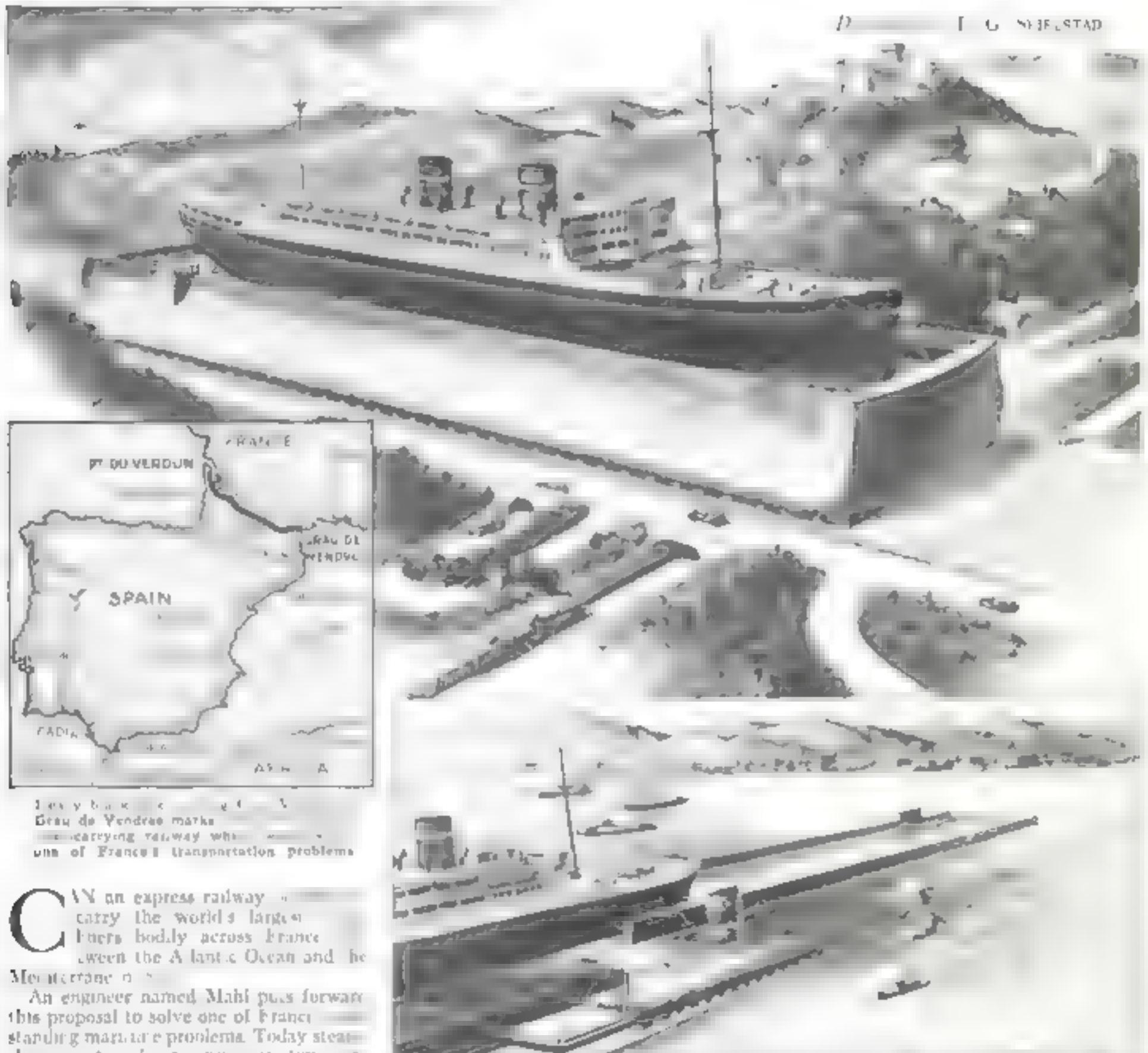
CIRCULAR film disks replace standard film in a new motion picture projector, designed for educational and advertising use. According to the inventor, the disks are far less fragile than ordinary film and can be projected 100 times without breaking or other damage. The apparatus includes a special printing machine to transfer the pictures from conventional film to the sensitive en-

AME. In this form, the pictures are arranged spirally leaving a hole in the center of the disk. The images are so reduced in size in the printing process that each disk takes the place of 1,000 feet of ordinary film.



At top, a special printing machine is at work transferring pictures from movie film to round disk. Above, close-up of section of one of the film disks, showing spiral arrangement of frames

Giant Railway for Ocean Liners



D. G. SHEELSTAD

Key block in a plan to
ease de Vendres marks
a carrying railway which
will solve France's transportation problems.

CAN an express railway carry the world's largest liners bodily across France between the Atlantic Ocean and the Mediterranean?

An engineer named Mahi puts forward this proposal to solve one of France's standing maritime problems. Today steamships must make a strenuous, time-consuming journey around Spain to get from one body of water to the other. So often discussed and debated that it already has a name, "The Canal of The Two Seas," is a long-cherished French project of a deep waterway between the country's two coastlines. Mahi's bold alternative would obviate the need of such a canal. His ship-carrying railway, he declares, could be constructed at half the cost of the canal.

"Cars" for this amazing railway would be giant reservoirs of water rolling upon trucks—literally, "canal locks on wheels" as the inventor describes them. Each would hold enough water to float a vessel twice the size of the *Île de France*. According to the inventor's plans, the car will be provided with ten axles, each bearing twelve wheels rolling upon rails nine feet apart and embedded in concrete. The total length of the car is 650 feet, or nearly three city blocks.

The projected route of the railway is between the point of Vézduin, on the At-

Drawing suggests manner in which the gigantic railway cars would take on board ocean-going vessels and rush them across France from the Atlantic to the Mediterranean in a few hours

lantic coast, and Grau de Vendres, on the Mediterranean—a distance of about three hundred miles. At each terminal, an inclined extension of the railway will run down into the water. When a liner wishes to be transported, and the fee for passage has been paid, one of the reservoir cars will descend the inclined rails until its wheels are well below the surface of the water. A swinging bascule door at the forward end will be open during this process, allowing water to enter the car. The liner is then maneuvered by tugs into the car. The bascule door is closed and made watertight. Slowly the car re-mounts the incline with its massive burden of water and ship.

Once on level ground, the car moves across country under the impulse of its self-contained electric motors at a speed greater than that possible to ships in a

canal. When it arrives at the destination, the liner is set down in the water by reversing the process used in picking it up. Again the bascule door swings open, and the vessel steams out and on its way.

To build more than one of the big tracks required by this giant railway would be of prohibitive cost. Therefore turn-outs will be constructed at certain points along the right-of-way, where one of the cars can be shifted laterally off the track to allow the passage of another going in the opposite direction.

Despite the boldness of Mahi's plan, it has captured the attention of engineers seeking a solution to France's waterway problem. In its favor is pointed out the immensity of the task of building such a canal as has hitherto been proposed—a "big ditch" that would have to be nearly ten times as long as the Panama Canal.

Here's the World's First Porcelain House



The picture of the first porcelain house was taken just before it was finished. Walls, roof and chimney are covered with the enamel which remained clean even after being washed with soap and water.

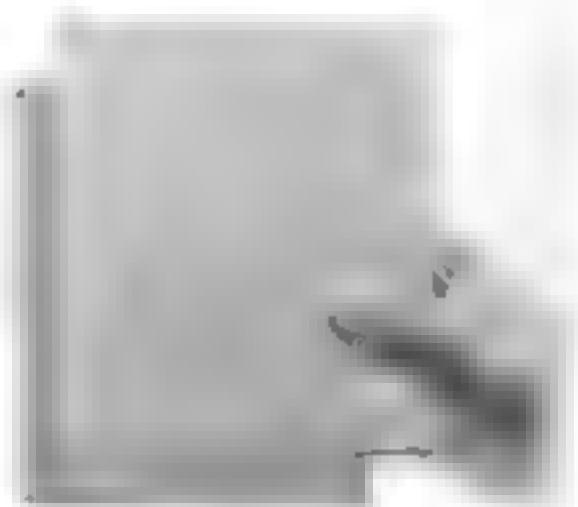


Welding process to build porcelain shingles of dirt brick on the roof of this porcelain house, just built in Cleveland.

Mineral wool and fiber board were laid over steel to insulate the house from heat and cold.

IMAGINE a home that costs little to build, never needs painting, and requires only soap and water to keep its exterior clean—and you will have a good idea of the world's first "porcelain house," which has just been completed at Cleveland, Ohio.

Bull-colored walls of this eight-room dwelling present a spotless surface. They are covered with shingles of porcelain enamel, on steel backing. Roof and chimney are similarly finished in porcelain. Should the house capture public fancy it may set the style for one of the most startling innovations in architecture in recent years.



Shingles like this were used on the porcelain building. The enamel laid on a backing of steel, is thoroughly durable.

Everyone knows the durable qualities of porcelain enamel as used in bathtubs and washbasins. But could it be applied successfully to external walls? Roadside refreshment stands, covered with porcelain, were the first to demonstrate that it could. Following their success, a Cleveland firm sponsored an adaptation of the idea to home building.

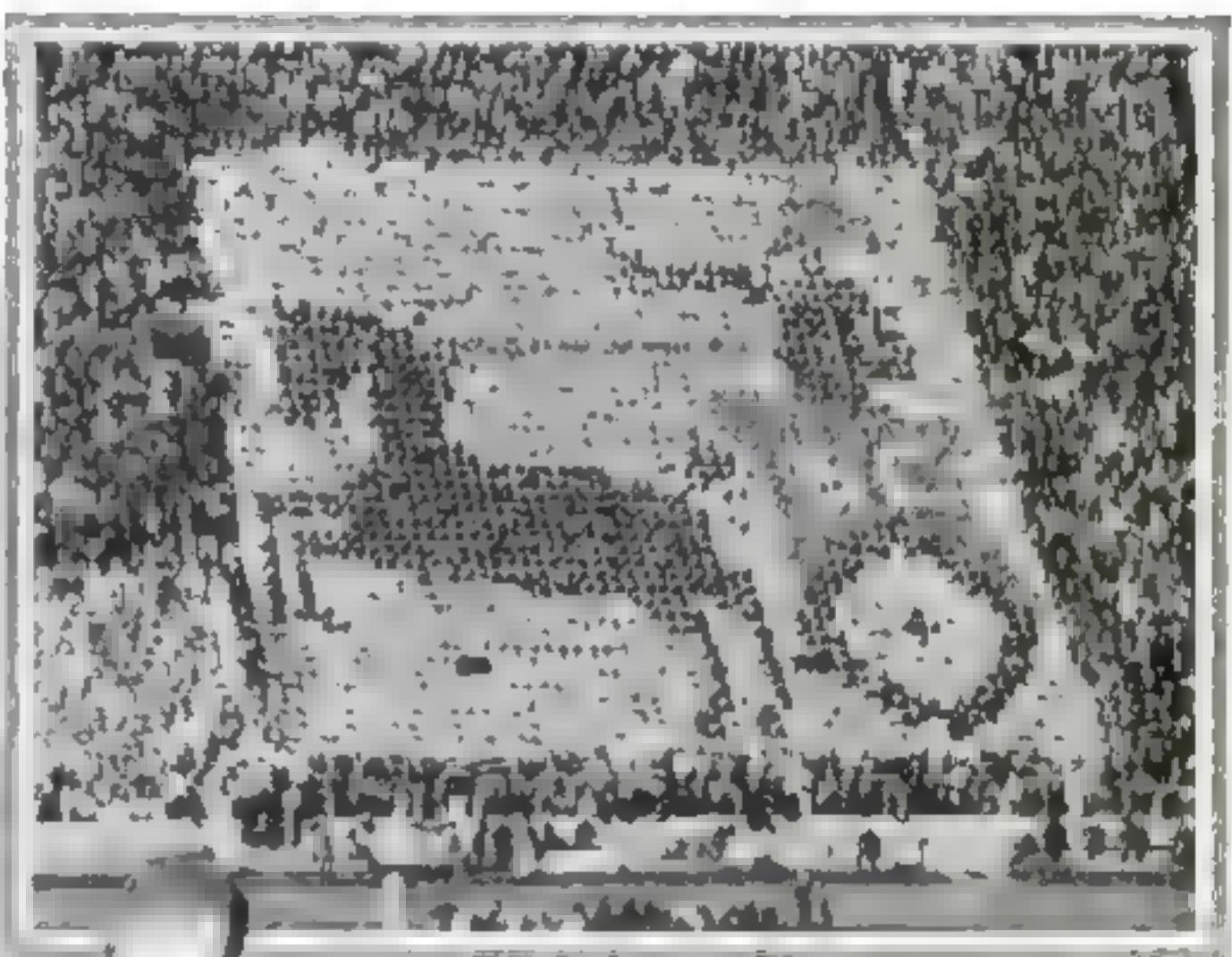
Welded steel framework supports the house. Mineral wool and fiber board insulate its walls against heat and cold. The roof shingles are of three shades of russet or rust color. A band of silvery-green trim runs along the side walls. None of the porcelain has the familiar glossy appearance. Its finish is dull or "matte." Paint is employed nowhere on the exterior—giving the owner a welcome relief from painting bills. Dirt and grime are easily removed by ordinary washing. An inside covering of porcelain is provided for the kitchen, bathroom, and recreation room.

The result is an entirely fireproof home that may be built on a mass production basis. Since most of the material may be made in advance, erection requires little time. Raising the steel frame for the two-story house in Cleveland, and for a garage, took only three weeks.

Welding together the steel framework that supports the porcelain house. Only three weeks were required to put up the framework for the two-story house and a big garage.

Football Rooters in Living Pictures

Spectacular Stunts at College Games Are All Carefully Worked Out with Crayon and Paper



Above, size being measured with string transfer to paper as shown. Below, Trojan horse card designs and sea turtle cards are checked.

HIGH in the air in the grandstand at the football game, formless, yet well-ordered designs in spectacular between-halves stunts. At the University of California, Trojan rooters have given this picturesque art to a high degree of perfection, and pictures on this page show how it is done.

The rooter himself never sees the complete picture at a game, and plays his mechanical part bändly in front of him before his face a ten and a half foot square board on which the picture is to be drawn. The board is covered with black and yellow cards.

Workmen are needed. A man to be the head cheerleader, one



Above, rooters with cards picture the Trojan horse and sea turtle.

of the picture—perhaps a Trojan warrior brandishing a spear—is then transferred to a piece of graph paper, which is ruled with horizontal and vertical lines resembling a grid. When this is done, the rooter begins to draw the picture on the board, using the graph paper as a guide. He uses a stick or brush to move the cards around, and the result is a living picture.

Will TINY MOTORS fill Air with

Glider Planes?



18



At top, glider powered with 24 horsepower motor. Above, stay plane pilot can push around

ASIXTY-FOOT plane with a three-horsepower motor could be built and flown for sport. Recent advances in engine construction and lessons learned from soaring ships have made possible this remarkable feat.

A few days ago, I had lunch with several designers and the conversation turned to the possibility of flying with midget motors especially designed to power featherweight soaring planes. Afterwards, I dug up some tables and a slide-rule at home and made a few calculations. A single-cylinder gasoline engine, no larger than a quart milk bottle, I found, could furnish sufficient power to fly a ship with a span of sixty feet. Such a machine would open up a new, fascinating field of sport flying.

It is an old saying among designers that "You can fly a barn door if you have power enough." Since 1903, the story of aviation has been largely a record of increasing horsepower.

The original Wright biplane, you remember, struggled into the air with a

crude sixteen-horsepower engine. Blériot crossed the English Channel with a twenty-one horsepower Antoinette. In contrast, take two recent record breakers. Last year's Schneider Cup seaplane, with a wing-span of thirty feet, carried a 2,600-horsepower engine and the fifty-three-ton DO-X crossed the Atlantic driven by a battery of engines that totaled 8,000 horsepower.

The main work of aerial designers during the last twenty years has been producing bigger, higher-powered planes. Comparatively little research has been carried on to find an answer to the question, "What is the smallest engine that will fly a plane?"

Not long ago an inventor came to my New York office with plans for a "pedal plane," designed to eliminate the engine. Through an arrangement of pedals and gears, he expected to keep the propeller spinning, and the craft aloft, by man-power alone. Hundreds of other experimenters, including the famous pioneers Otto Lilienthal and John J. Montgom-

By
**CAPTAIN FRANK T.
COURTNEY**

Veteran Pilot Tells How
Wings Could Fly with a

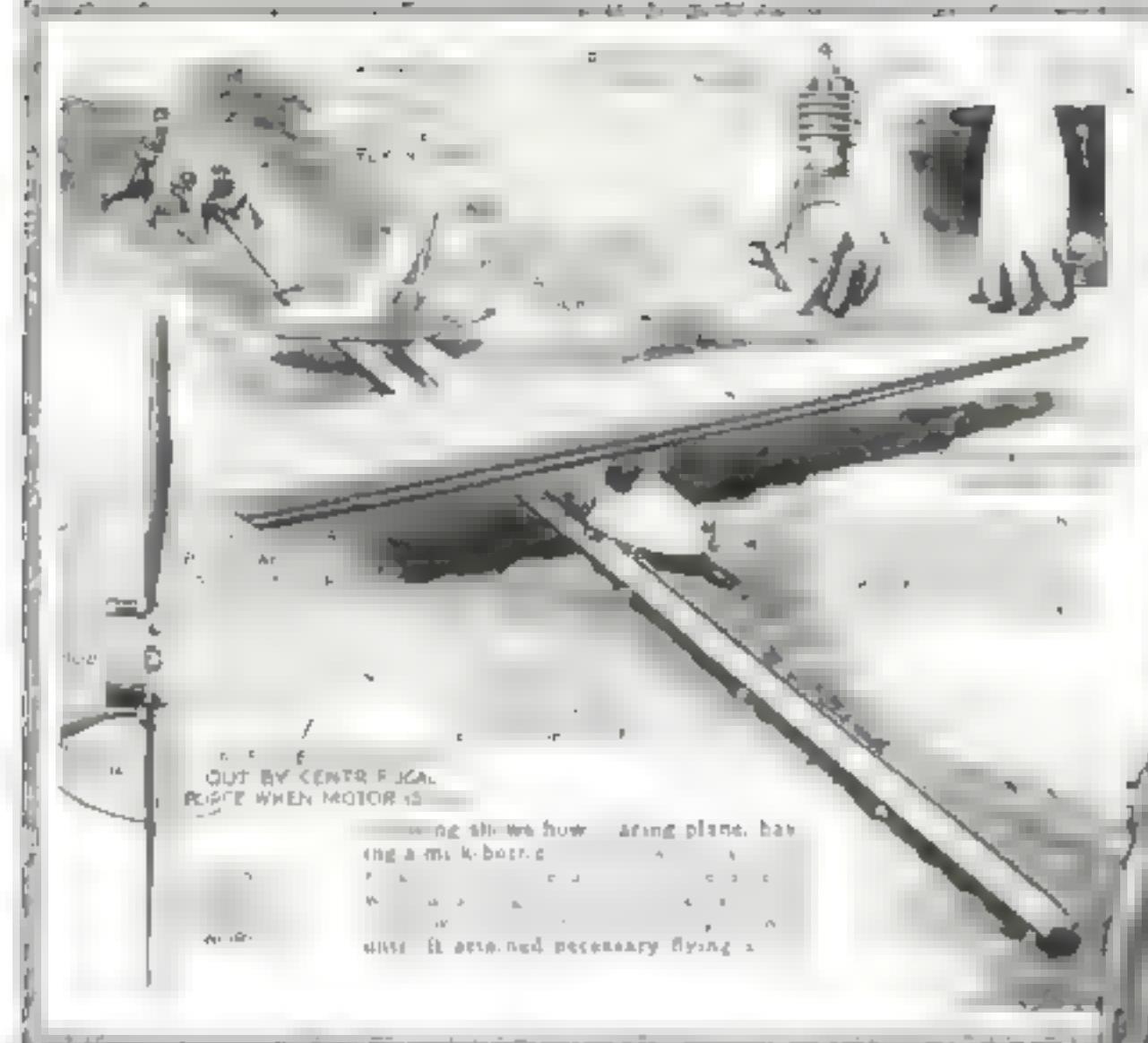
cry, tried the same thing without success. The reason man-power planes are always a failure is that man-power isn't powerful enough.

The average laborer, tests in one American laboratory recently showed, produces no more than from one-tenth to one-eighth of a horsepower throughout his working day. One horsepower is the force required to lift 33,000 pounds one foot in one minute. In actual practice, it would take the strength of four and a half horses to produce one horsepower.

Several years ago, I made a simple test to find the maximum horsepower I could develop during a short period. While a friend timed me with a stopwatch, I took a running start and sprinted up a flight of stairs at top speed. By learning the time it took me to lift my weight the height of the stairs, I could calculate how many pounds, at that rate, I would have lifted in one minute, or what horsepower I was developing. The peak mark, as I remember it, was a little over one horsepower. And the longest I could hold that was for ten seconds and probably the running start helped.

Such feeble bursts of power, further reduced by the friction of gears and the inefficiency of propellers, make sustained flight by man-power out of the question. Birds, that propel themselves through the sky, have tremendous muscles in proportion to their weight. The "white meat" along a chicken's breastbone represents the heavy muscles that flap the wings. Besides, an immense amount of energy is consumed by birds in flying. For instance, it has been

Motors, like the one shown below, weight
less than a pound. They have less than
one-fifth horsepower per square foot of
supporting surface.



Glider with Sixty-Foot Tiny Ten-Pound Engine

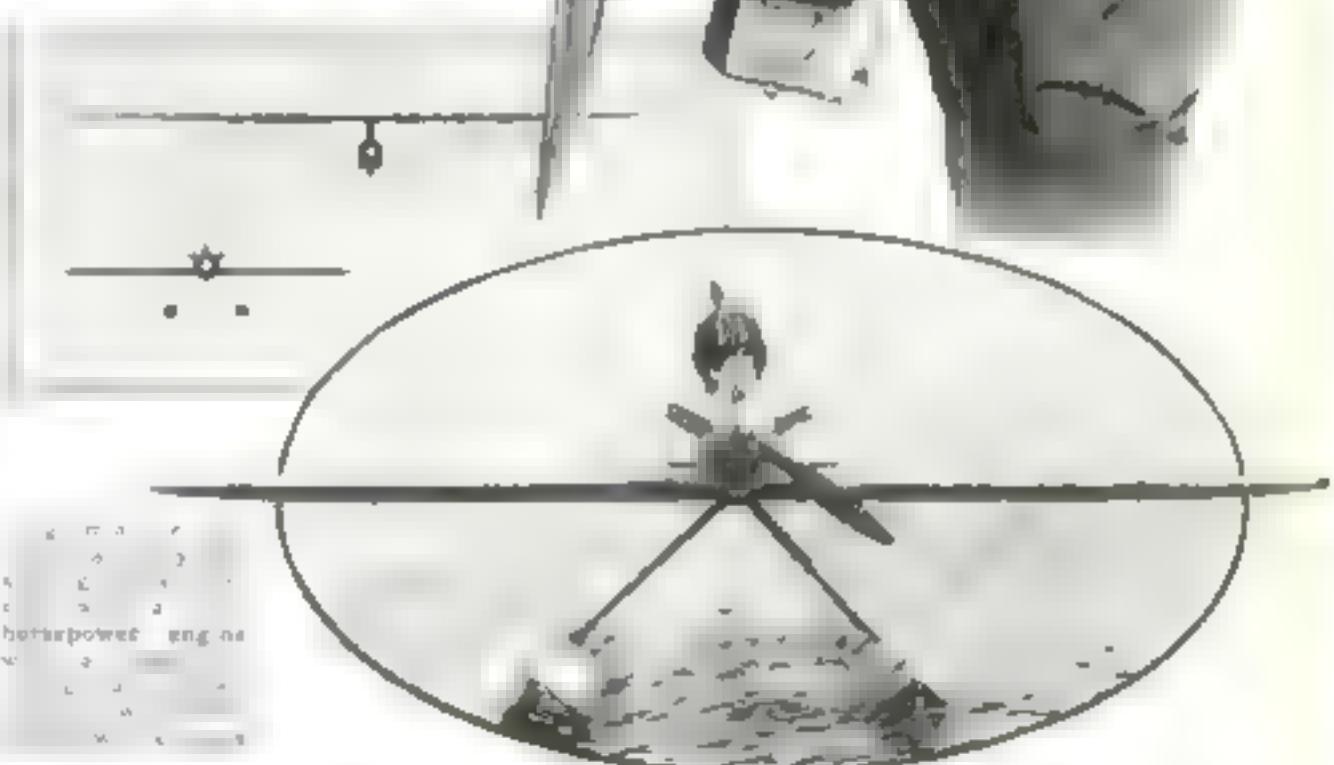
estimated that an active crow is capable of eating a dozen times its own weight in a single day.

In spite of these facts man-power planes continue to be proposed. During the eighteen years I have been engaged in flying test piloting and engineering work I have seen scores. The commonest kind is the "winged bicycle." The idea is to pedal at top speed across a field until the wings lift you into the air.

In 1922 at the Wford Hill soaring and gliding meet in England I watched on of these "flying bikes" make a dozen attempts to take off. Every time just before sufficient speed was attained the wings would begin to lift the weight on the wheels. They would spin around, unable to "grip" the ground, and no matter how hard the operator pedaled, he could not give his apparatus the last-minute drive necessary to get off.

When Darius Green, in the famous Trowbridge poem, jumped off the barn roof with his home-made wings and landed with a thump, he shook his head and muttered, "The birds can fly so why can't I?" The answer is: "Because you aren't strong enough. You need a motor." But, how small can this motor be?

In heavier-than-air flight, most of the power is required on the takeoff and in climbing. A twelve-passenger Bellanca airplane, for example, can maintain level flight on about 145 horsepower. But the Cyclone engine it carries develops more than three and a half times that power, the excess going in a quick takeoff, fast climb, and high speed.



The type of machine that requires the least power to fly in the air is a streamlined, wide-winged soaring ship. A craft like the American-built Hellet-Hawk which weighs, empty, 287 pounds, has a wing area of 167 square feet, and a span of approximately sixty feet, could be kept in level flight by a motor delivering two horsepower at the propeller. An additional horsepower would permit it to gain altitude at the rate of about eighty feet a minute.

In the past, most attempts at building light planes have employed motorcycle engines to furnish the power. I remember one little ship, named the "Wren," that got off from a long stretch of sand on the English seacoast several years ago with a seven-horsepower motorcycle motor. That is the lowest-powered plane ever to fly, so far as I know.

According to the U. S. Department of

Commerce, any machine that has less than one-fifth horsepower per square foot of supporting surface, is in the light-plane class. The midget-motored machine, suggested in this article, would have less than one-fifth of a horsepower per square foot and, of course, would require a special category with the Department of Commerce.

Motorcycle engines are always comparatively heavy. What is needed, and what has never yet been supplied, is a tiny, super-light motor, especially designed for the work. Every ounce that can be cut from the weight of the power-plant lessens the load the motor has to drag "uphill" in climbing and reduces the size of the engine required.

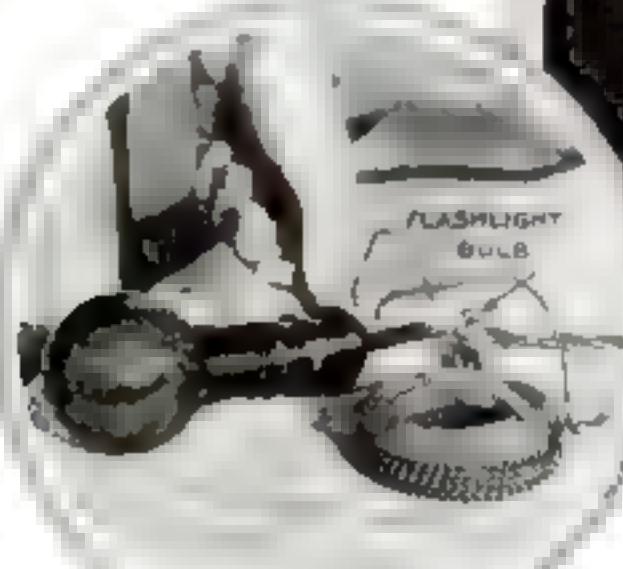
For a number of years, an experimenter in Chicago, Elmer A. Wal, has been turning out unusual miniature gas engines for model air-

(Continued on page 110)

Home Tests of Nature's Secrets

You Can Demonstrate for Yourself the Action of Mysterious Laws in the Realm of Science by Using the Things That Are Always at Hand

TESTING A STRANGE LAW. This experiment, which demonstrates a useful law of electricity, can be performed easily with two coils of bell wire, a small flashlight, and a 100-watt bulb. Connect one coil of wire in series with the bulb and connect the flashlight directly to the other coil. Turn on the current so the bulb is lighted and then bring the two coils of wire close together. As you do so, the flashlight will light. This act on is the result of induction, a principle used in constructing transformers.

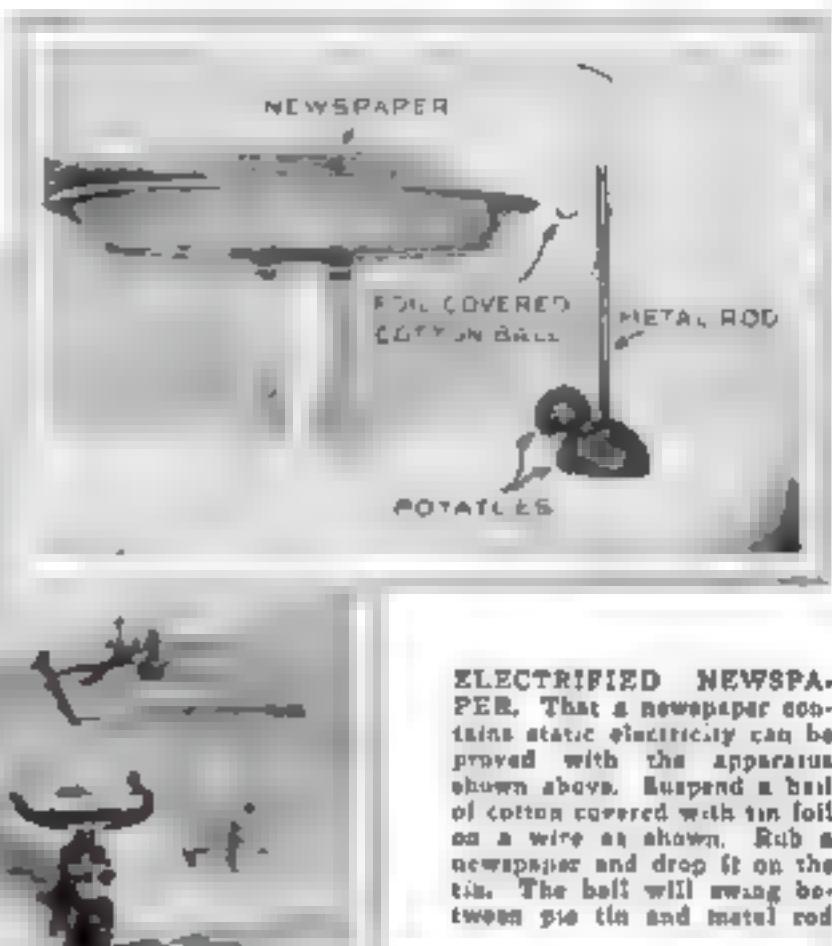


HOW TO GET GREAT HEAT. Scrape a teaspoonful of iron rust off an old pipe and mix it with the aluminum powder found in the bottom of a bottle of aluminum paint, being sure that a little of the paint solvent remains in the powder. If this mixture is ignited, there will be a puff, a blinding flash—and a hole burned deeply into whatever substance the mixture was resting upon. In this miniature thermite welding system, enormous heat has been generated.

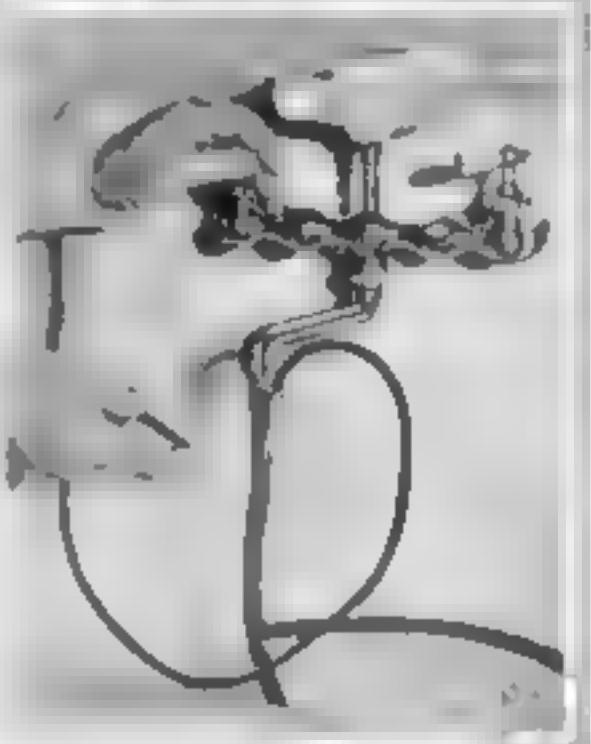
SIMPLER AIR PUMP. With the vacuum pump, right, which can be put together for twenty-five cents, many interesting home experiments can be performed. The pump is made of ten cents worth of windshield wiper hose, ten cents worth of larger hose, and the spout from a five cent oil can. When connections are made suction is created at the end of small hose.



BEATER WARMS WATER. A mysterious little experiment is possible with an electrically driven stirring machine, a bowl of water, and a thermometer. If you place the thermometer in the water while it is being violently agitated by the machine, you will find that the water's temperature rises slightly. This is called the mechanical equivalent of heat, and it is believed that the heat is generated in the water by the friction of the molecules of water gliding over each other at high speed.



ELECTRIFIED NEWSPAPER. That a newspaper contains static electricity can be proved with the apparatus shown above. Suspend a ball of cotton covered with tin foil on a wire as shown. Rub a newspaper and drop it on the ball. The ball will swing between tin and metal rod.



WANDERING MUSIC. Take two glasses as shown at left, and across the top of one draw lightly a thin rubber band, fastening it in place with cement and string. Plucking the rubber band will start the glass vibrating. Now if the second glass is brought close to the first, it also will vibrate because it is in resonance with the first glass. If with your hand you stop the first glass, the second will continue to vibrate.

COLD MAKES WATER BOIL. Here's an experiment with which you can baffle your friends. Boil water in a bottle and then cap it tightly. In a few minutes, steam will condense the neck of the bottle and the water will stop boiling. Now hold bottle under the cold water faucet, so water strikes portion of bottle containing the steam. The water will again begin to boil, as the cold condenses the steam, creates a vacuum, and reduces pressure so residual heat boils water.

Pilgrim Fathers' Homes Seen in Exhibit

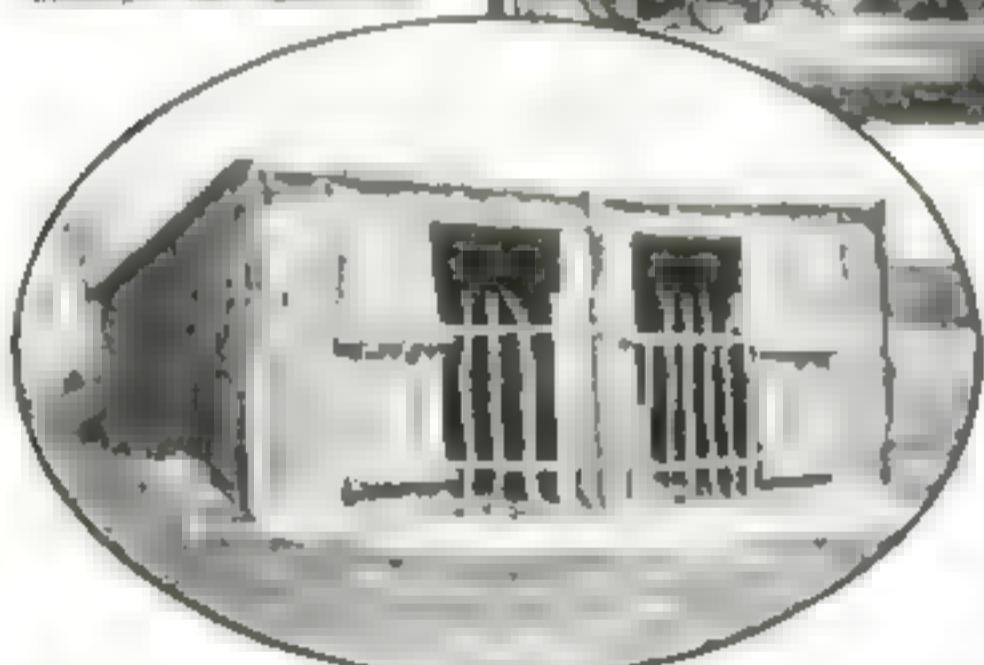


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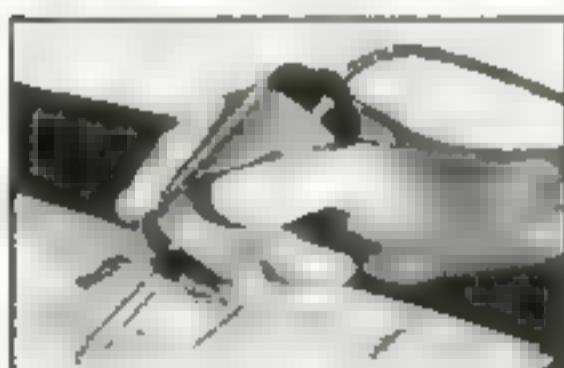


After very early
in the New World
they built
from poles
while logs were cut



One of the log barns in which the Pilgrim Fathers sheltered their cattle rebuilt for exposition of Colonial history at Salem, Mass.

To show what life was like the Pilgrim Fathers lived a unique exhibition is now open at Salem, Mass. It consists of a group of models showing the dwellings of the first colonists and their surroundings. The models show the evolution from the simple wigwams of the Indians to the more substantial houses of 1620 to the more substantial houses of 1640. After inspiring such an exhibit, those who live in the comparative ease of the twentieth century have a better idea of the stern, simple surroundings in which the pioneers celebrated their first Thanksgiving. In their successful struggle to gain a foothold in what was then a wilderness, they were forced to make the best of what they could find. Tools were scarce and implements were made of wood. Nails were at a premium and as late as 1680 they were used in Rhode Island in lieu of money.



ELECTRIC ERASER DOES THE RUBBING FOR YOU

An ERASER that does the rubbing for you in removing pen and pencil marks, is now on the market. The machine receives electric current through a six-foot cord that can be plugged into any convenience outlet.

GIANT CLAM CAN TRAP HUMAN VICTIMS

A GIANT clam, found in Australian and Philippine reefs can trap human victims, a recent report to the American Museum of Natural History states. When its open shells lie flush with a reef or hidden below water, an inadvertent wader may step in. Then the jaws close and only a crowbar can open them.

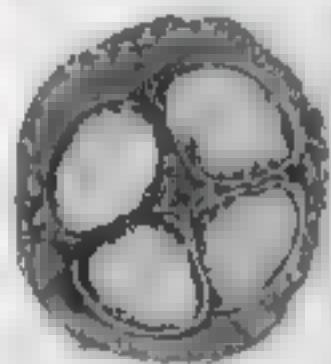


Pb. opposite clam with shells four feet in diameter and so powerful that when they close on human being, a crowbar is needed to force them apart

Our Tung Oil Industry Started in Cemetery



A left is a
cemetery with
the tree. The
right is a
close-up of
the tree's
seed pods.



An old tung tree in a
cemetery. It takes a
long time to bear fruit.
The Chinese
name for heart-bearing tung

To vivify seedling trees, neglected for years in a Florida cemetery, has just been traced the birth of an American industry valued in millions of dollars. Thirty-one thousand acres of the southern United States are now devoted to the cultivation of the tung tree, according to a recent

Government survey. Seeds of this tree yield an oil that is widely used in paints and varnishes. (P. S. M., July, '31, p. 52.) China held a virtual monopoly of the tung oil industry until the discovery of the tung seedlings at Tallahassee, Fla. Raised from Chinese seed, they showed

that the tree could be grown successfully in this country. The seedlings were transplanted. Four died, but the fifth flourished. It furnished the seeds from which America's first bearing grove of tung trees was grown. The tree has proved to be hardy, grows rapidly, and is profitable.

ROLLERS HELP LAUNCH NEW LIFEBOAT



Above: demonstration of how new flotation boat can roll down hull of ship on rollers.

Close-up of lifeboat that is equipped with two pairs of rollers on which it can be launched and by which it is also driven.



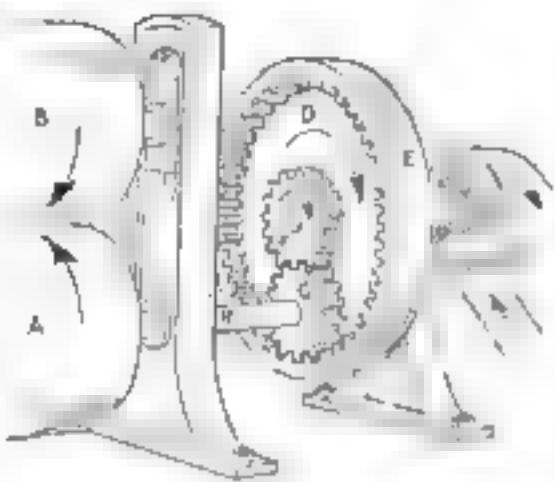
GOLF SCORE ON METAL

An all-metal scorecard for golfers, that may be used over and over again is the product of a Hooperston, Ill., inventor. It consists of two hinged leaves stamped out of aluminum, with twenty-four marker strips. Each strip is numbered up to nine.

FREAK LEMON IS PINK

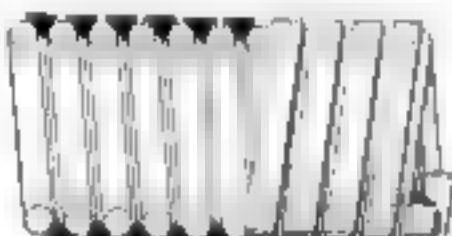
PINK lemonade might be made without resort to artificial coloring from the fruit of an odd lemon tree, discovered in a Burbank, Calif., orchard not long ago by an expert of the U. S. Department of Agriculture. The lemons from this tree have pink flesh and juice.

Can You Invent It?



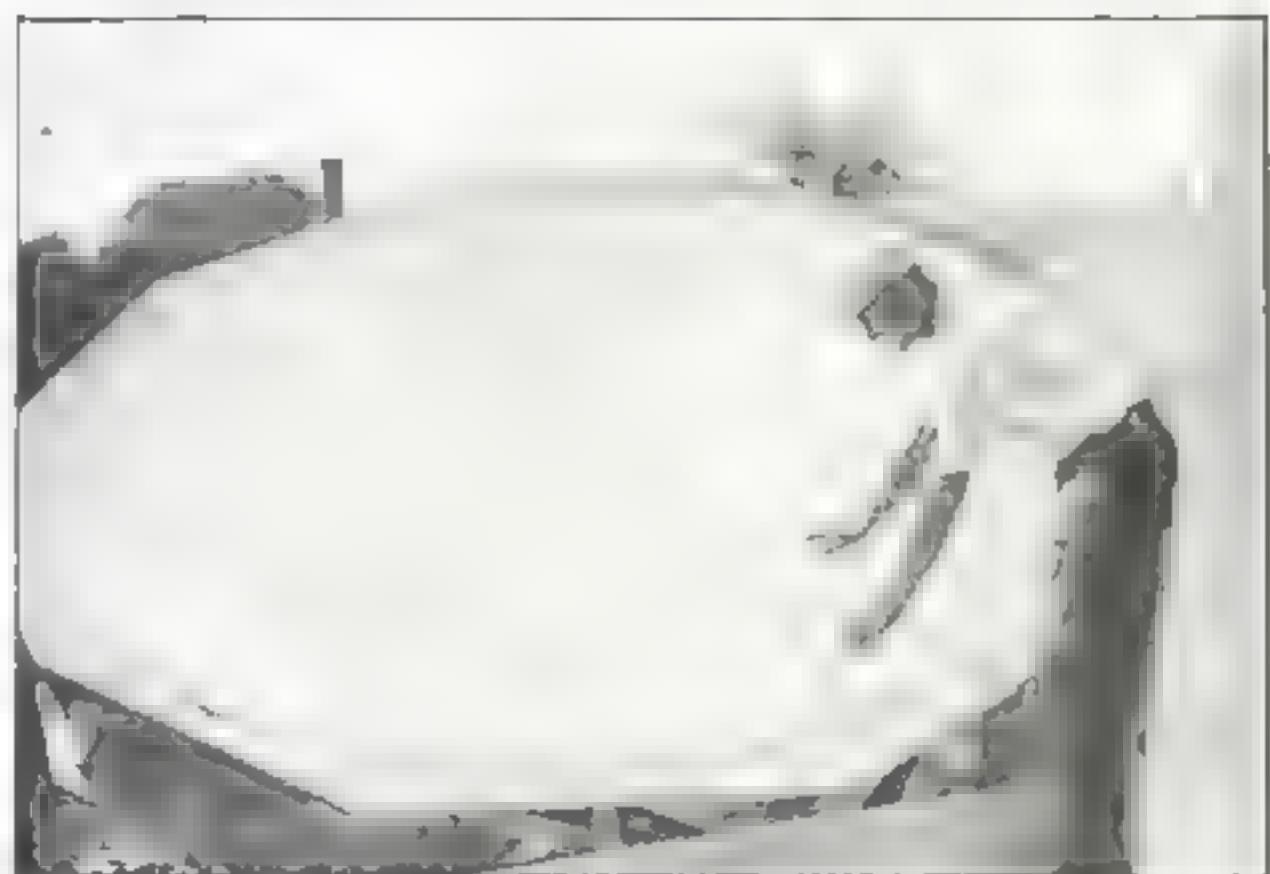
CAN you make the changes needed in this mechanism to enable the clothes-mangle to operate in the following way. It is desired to have the two rolls, *A* and *B*, turn slowly inward, in the direction of the arrows, and then reverse their directions of motion. After reversal, they must turn rapidly outward. The power is delivered to the mangle by the belt, which rotates the shaft *C*, carrying the disk *D*, upon which are immovably fixed the internal gear ring *E* and the cogwheel *F*. The cog-wheel *G*, keyed upon the shaft *H*, rotates the lower mangle-roll. The upper rolls upon the lower by contact, as it is fitted with sliding bearings at *I*.

LAST month you were given the problem of using an open wound coil of round brass spring wire to produce a hollow flexible tube of the same diameter as the coil, without in any way modifying the coil. You were free to make any additions you liked to the coil. In order to do this, a coil of triangular wire must be wound tightly over it. The inner faces of the triangular wire are thus wedged into contact with the coils of the round wire. When the coil is bent, the triangular wire is crowded out on one side and let in proportionately on the other, thus keeping the continuous joint between the two coils always tight, with the parts always in close contact. The diagram shows the left end cut away to reveal the relationship between the two coils and how the hollow flexible tube will now operate.



Drawing shows how coil of spring wire is converted into flexible tube of same diameter

SUN FURNACE TO GIVE GREAT HEAT

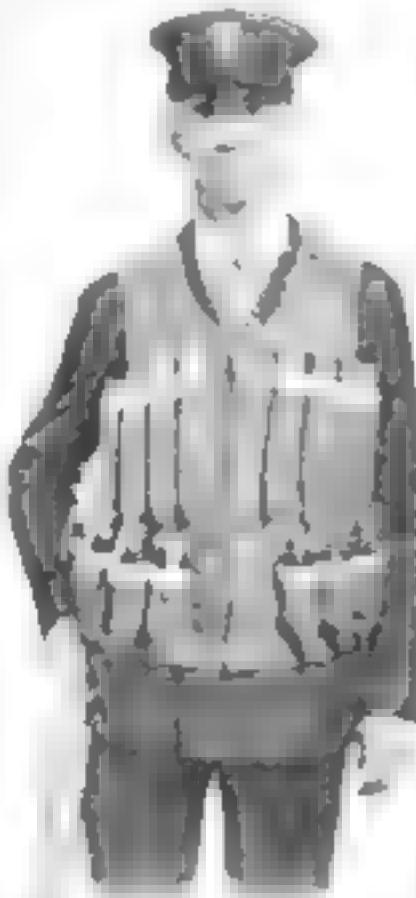


HARVESTING the sun's rays to fuse pottery materials is the aim of Paul Morrison and George Aderhold, of Saxonburg, Pa. They are constructing a giant solar furnace that when completed, will be 100 feet in diameter. Concentric rings of polished, chromium-plated metal will reflect the

sun's rays and bring them to a focus seven feet from the furnace's center. At this point, the experimenters expect a temperature of 5,000 degrees F. to be obtained. The photograph above shows one of the sections of the solar furnace, which, it is said, will be the largest in the country.

PRISON GUARDS GET NEW WARLIKE VEST

WARLITE in men is a new vest designed for prison guards, allowing free use of both arms. Eight tear gas grenades and eight riot gun shells may be carried in the garment, each in an individual elastic pocket so that they are instantly accessible. Wearing the vest over his uniform or blouse, a guard becomes a walking ammunition carrier ready for quick action in the presence of any prison emergency.



New vest for prison guards holds tear gas bombs and riot gun shells



CLEAN STAINED GLASS WINDOWS WITH DISCARDED RAZOR BLADES

A NEW use for old safety razor blades was found recently when the stained glass windows of famous Trinity Church in New York City received their first cleaning in eighty-six years. In expert hands, the blades successfully removed all of the dirt. Scrubbing with washing soda completed the task.

BIG PEAT BED MOVES

LIKE a glacier of black ice, ten million cubic feet of peat moved more than two miles down a valley in County Mayo, Ireland, a few months ago, in one of the few known bog flows of history. The semi-liquid mass, advancing like a wall, carried along stones and boulders.

Bow of *Bessinger*, right, sank in New York harbor, was cut off with under-water torches, raised and towed to scrap heap. Below: salvage diver with oxy-electric cutting torch, ready to cut away chain fouling a ship's propeller.



Twelve-inch gasoline pump drawing water from a patched hull, as sunken boat can be raised and towed away.

BRINGING dead ships to life, saving the sinking and disabled, rescuing cargoes, raising treasure from the deep! These are the romantic and hazardous everyday duties of the little known race of men and the odd fleet that carry on the strange business of the Black Horse of the Sea.

Flying a rectangle of white bearing the device of a riderless black horse wildly running, a powerful tug races halfway across the Atlantic to the assistance of a freighter disabled by engine trouble. Two others, towing colossal floating derricks, hasten toward Buzzards Bay to refloat a trim yacht stranded on the rocks.



Fighting the Sea for WRECKED

By
Robert E. Martin

Under the same queer emblem, a band of divers grope in the silt at the bottom of New York harbor, patching holes in the steel shell of a \$1,000,000 Government dredge preparatory to pumping it out, raising it, and putting it again in service. Off the lonely coast of Lower California, with armed guards patrolling the deck of their ship day and night, Black Horse divers and salvage experts wrest from the ocean a fortune in sunken gold.

Nearly three quarters of a century ago the Black Horse flag was first broken out by Captain L. J. Merritt from the mainmast of the *Henry W. Johnson*, a Gloucester mackerel fisherman turned salvage vessel. A symbol of the fast horses that bore the messengers of the old coast patrol, this device—by the daring exploits of its ship and crew—marked the beginning of a new swift succor on the deep.

Today, as house flag of Merritt-Chapman & Scott, largest marine salvage concern in this hemisphere, its vessels ply from Maine to the Caribbean, from Alaska to the South Seas. To cope with the vast and rapid growth of modern shipping, it has developed almost a separate science with a technique of its own. With millions of dollars worth of specialized equipment, a hundred ships—super-powered tugs, lighters, barges, floating derricks capable of lifting from fifty to 350 tons—and crews of several thousand veterans at its precarious work, the Black Horse now tackles the myriad perilous problems of the twentieth century sea.

Versatility, resourcefulness, determination, and no small measure of courage are the stock requirements of the men who man the salvage ships; for all salvage jobs are trying, many hazardous, and no two exactly alike.

The salvage officer, director of operations, must be engineer, seaman, executive, and master of a dozen trades. The divers, his underwater hands and eyes, must be also marine surveyors, masons, mechanics, carpenters, experts with the oxy-electric torch. His crew must be able to turn to anything from sailing the vessel, constructing wooden braces and patches, sewing canvas bags, mixing concrete, handling pumps and winches, manipulating steel hawsers as big around as a man's neck, to saving lives and fighting pirates!

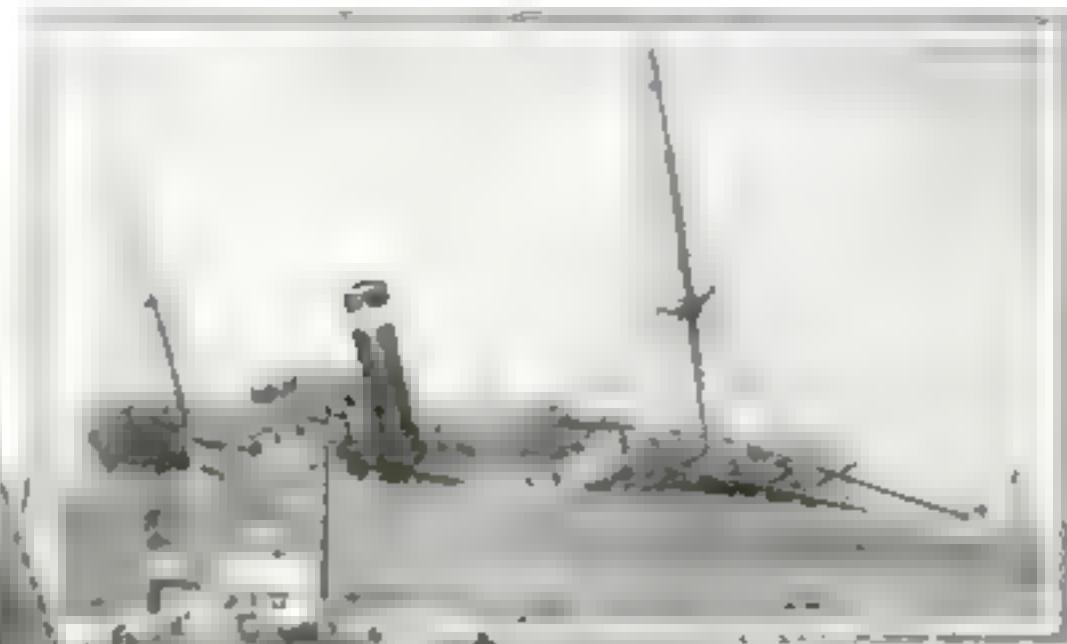
Wet, chilled to the bone, savors work day and night to float a freighter stranded on rocks. Divers apply patches of wood and concrete; slings are strung under the hull to the booms of great derricks, millions of gallons of water are thrown from the holds by gasoline pumps. Slowly the ship rises. She floats almost enough to be towed away. Then a gale breaks unexpectedly. Water must be let in; to steady her the ship must again be sunk! The work must begin all over some other day. Such is the perverse character of salvage.

In the days of wooden ships, terrible

This largest floating derrick in the world is seen in the *Monarch* at anchor in the Bay of Fundy, Canada.



How Strange Machines Help the Men Who Go Down to the Sea to Salvage Lost Treasure



Above: the *Caliphia* stranded on sand at Point Toxca, Mexico. The large equipment it carried was used to raise the vessel. Below: the *Monarch*, a giant floating derrick that was taken from the wreck of the *Carolina*.

SHIPS

Risks were necessary to take the crew of a stranded vessel—or for the salvage crew to get away, with bad weather and the ship in imminent danger of breaking up—but with the strong steel ships of today the ship is safer than the best of lifeboats.

Captain W. N. Davis, veteran salvager, remembers the case of the British Merchant *Ariosto* as a striking example of this truth. Stranded on the coast of North Carolina, near Hatteras Inlet, the *Ariosto* began to leak badly. Believing that his ship was on the dreaded Hatteras Shoals, the captain gave the order to launch the lifeboats. Two boats were lowered and all but the captain, chief engineer, and third officer got into them.

Just then a Coast Guard patrol discovered the ship and burned a red flare to show that she had been sighted. Realizing that help was near, the captain advised his men to come back on board, and a few did so. But the sight of the red flare was too much for the others, and with a cheer the boats started for the beach. Out of the shelter of the ship, both capsized. Of thirty-one men, not a man survived.

The *Ariosto* stranded on Christmas Eve; and from the following day until the end of March the salvage crew lived on board the ship in perfect safety. Her cargo of cotton was saved, her hull patched and pumped, and, except for bad luck with weather, the vessel herself would have been saved.

When a ship grounds on a sandy beach,

and the hole is broken, refloating is generally an easy matter. Having

fastened steel hawsers, fifteen inches in circumference, to the stranded vessel, the salvage ships anchor a safe distance seaward. Then, when the tide is full, powerful steam winches commence a slow but mighty tug-of-war. Inch by inch, shuddering under the strain, helped on by the deepening water, the stranded vessel is hauled to sea.

Often the Black Horse is called upon to remove a sunken ship that is too much battered to be reclaimed, but which, if left on the bottom, would be a danger to navigation. In New York harbor, where traffic is congested and collisions comparatively frequent, salvagers may be working on two or three such wrecks at the same time. Cut apart by dynamite and the underwater torch, the sections are either left on the bottom in deep water or lifted by derricks. One of these giant devices, the *Monarch*, is the most powerful floating derrick of its type in the world. Fitted with automatic ballasting apparatus, to compensate for the load, it can lift 350 tons overside.

Perhaps the most difficult job of marine salvage is the raising intact of a great liner from the bottom of the harbor waters—ready, after reconstruction in a dry dock to sail again. The raising of the *Muenchen*, sunk two years ago at her New York pier, is the most recent notable example. But the somewhat similar raising of the *St. Paul*, in 1918, had the added distinction of being the first great salvage venture in which was used the underwater cutting torch.

While being maneuvered at her pier in the Hudson River, the *St. Paul* mysteriously heeled over, sank, and settled in a dozen feet of mud. Two thousand tons of liquid mud poured through the breaks and open portholes.

More than fifty feet below the surface, unable to see a foot before their faces, divers groped through the muck, closed more than 500 openings in the hull.

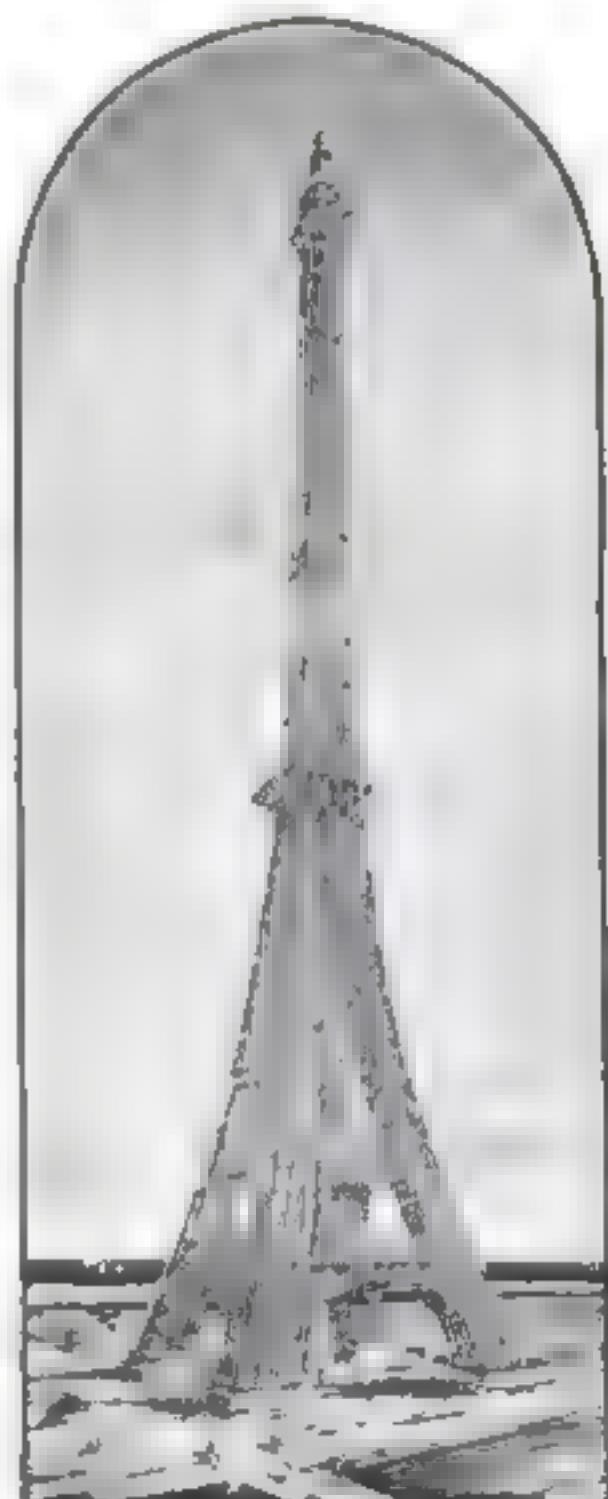
Though bulkheads are useful to a ship afloat, they were definite obstacles to the salvagers of the sunken *St. Paul*. To maintain the balance and facilitate the pumping out of the ship, these engineers wanted a free flow of water from stem to stern. So they decided to (*Continued on page 107*)

Ruins of Turkish Bath, Built by Romans, Found in England



Banquet hall in Roman ruin, unearthed at St. Albans, England, had a remarkable mosaic floor. Picture shows workers clearing away the dirt of centuries and exposing the floor's design.

TURKISH baths were popular among ancient Romans as early as 200 A.D., new discoveries show. Recent excavations at St. Albans, England, revealed the ruins of a palatial Roman establishment for steam bathing. An adjoining banqueting room indicated that a visit to the baths might have been attended with ceremony and festivity in those days. Expert craftsmen were evidently among the Romans who inhabited England, for among the finds was an exquisite mosaic floor rivaling the best of the period. According to archaeologists, the spot marks the site of the early Roman capital of south Britain.



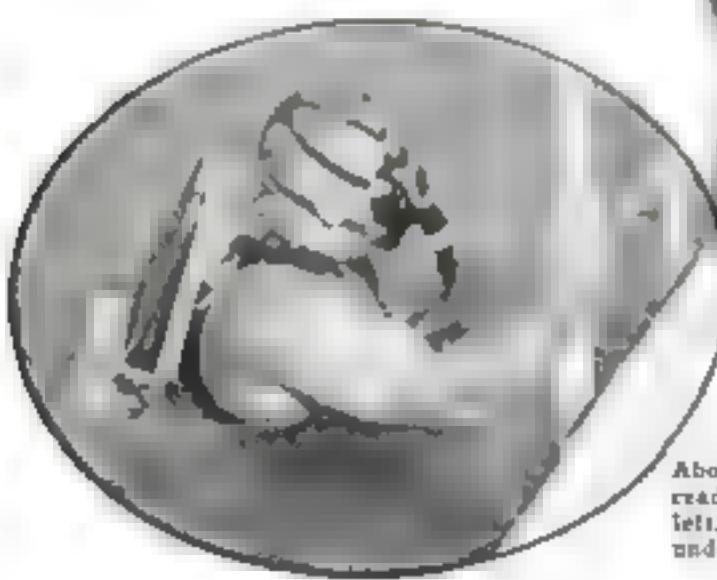
NEW TRAP CAN'T CATCH BIRDS



To protect birds and small animals from big-game traps, a safety attachment for standard steel traps has been devised by Albert M. Day, biologist of the U.S. Department of Agriculture. This invention—a thin detachable spring or wire—is slipped under the pan post of the trap as shown in the photograph at the left. After this has been done, the weight of a small animal will fail to spring the trap.

RESCUE MASK PROTECTS FROM GAS AND WATER

RESEMBLING the portable "lung" carried by a submarine crew to escape from a hatch beneath the water, a new type of rescue mask was tested recently by the emergency squad of New York City's police. Wearing this device one can brave smoke, water, and poisonous gas with impunity. In one of the tests pictured here a patrolman was successfully lowered to the bottom of a pool at Rockaway, N.Y., with only the new mask to supply him with oxygen during the time he was beneath the surface of the pool.

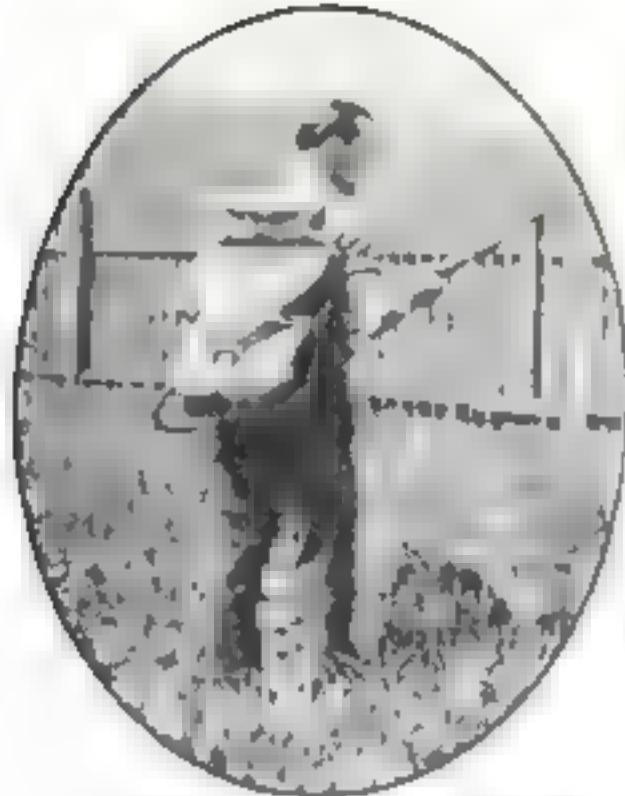


Above, wearing an oxygen tank, policeman is ready to don rescue mask like the one worn at left, which saved officer from drowning while under the water. Mask also protects from gas

PLAN TOWER 2,000 FEET HIGH FOR WORLD'S FAIR

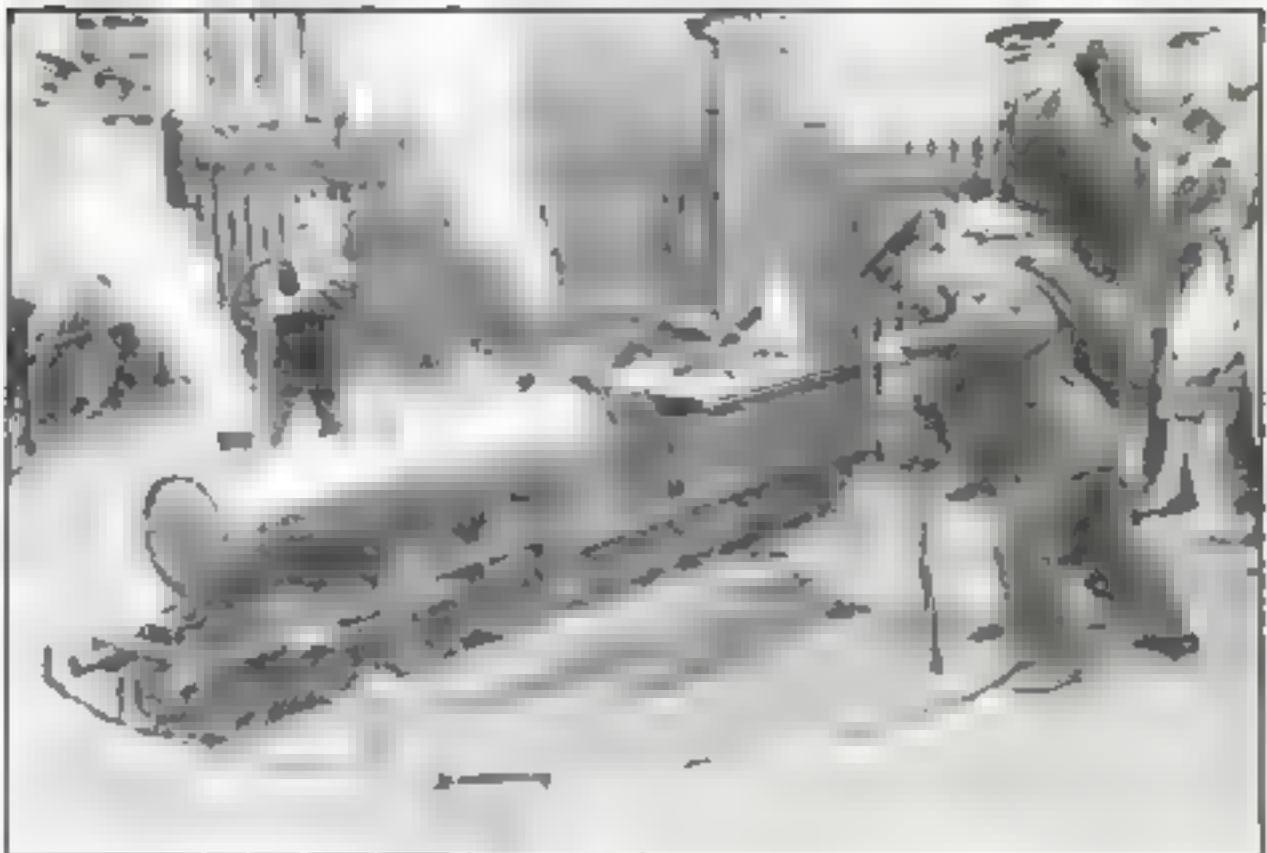
DWARFING any structure ever built by man, a tower of steel and aluminum more than 2,000 feet tall has been proposed for the 1933 World's Fair at Chicago. Frank A. Randall, Chicago consulting engineer and originator of the project, says such a tower is practicable from an engineering standpoint, and could be erected within seven months to serve as an attraction for sightseers. His design, shown above, outwardly resembles that of the Eiffel Tower of Paris, but the new tower would be double the height of that structure, and top the Empire State Building by 813 feet.

TINY RAILWAY HAS TURNTABLE



WATER BAG AND PUMP FOR FOREST RANGERS

A forest ranger becomes a one-man fire department with the aid of a new portable water bag. Carried on the back like a knapsack, it is made of processed cloth and holds more than five gallons of water for quenching a small blaze. A hand pump forces a strong stream of water from the small nozzle.

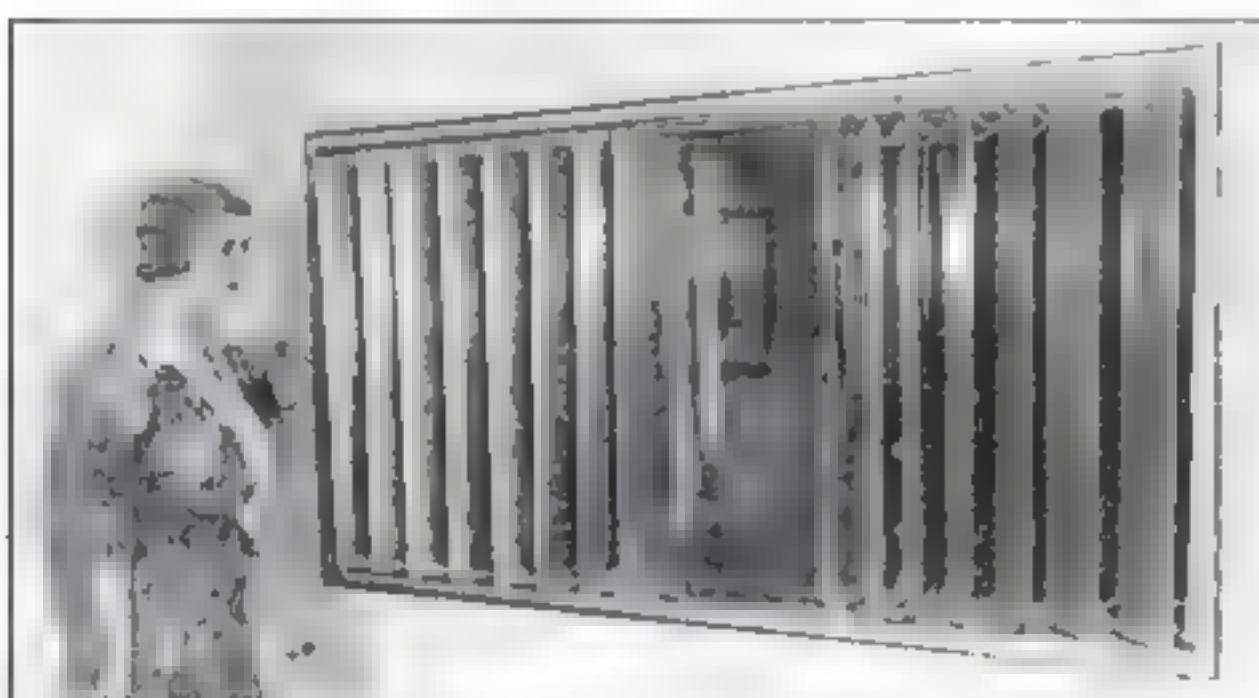


COMPLETE even to a turntable is a miniature railway system just completed at Southsea, England, and said to be the smallest passenger-carrying railroad of its kind in the country. Its rails are of nine and a half inch gauge. Trains are

towed by model locomotives patterned after those that draw the crack expresses of British lines. Enthusiastic youngsters need no urging to lend a hand in operating the diminutive turntable, shown in the photograph above.

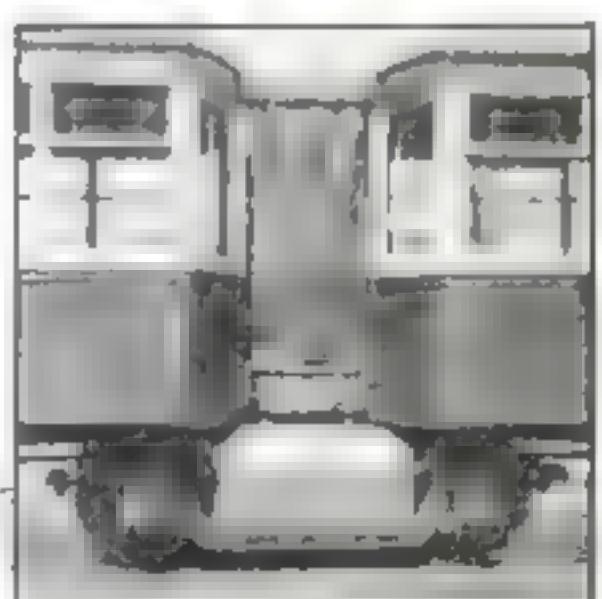
METAL WINDOW SHADES EXCLUDE STREET NOISES

ALUMINUM window shades, setting a modern note in interior decoration, have recently been perfected. According to the maker, they banish the nuisance of balky curtain rollers and soiled shades. The metal panels open or close at the touch of a cord, as illustrated at the left. They are said to be especially suited for use, not only in homes where quiet is desired, but in executive offices, excluding noise and insuring privacy during a conference.

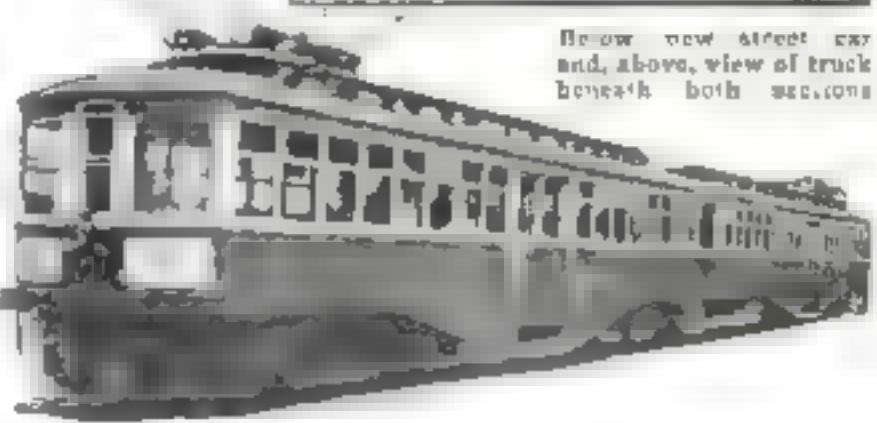


DOUBLE STREET CAR HAS HINGE IN THE CENTER

An economy in rapid transit is a two-in-one interurban car recently placed in service on a northern California line. The two hinged sections look like separate cars, but actually share a common truck at the center. Passengers enter and leave at the front end, where the conductor collects the fares. The rear section is reserved for smokers, and connects with the forward car through a vestibule. Two conductors and a motorman were required on a two car train before the introduction of the new combination units.



Below, view of street car; and, above, view of truck beneath both sections.



SLUG OPENS NEW LOCK

COIN-SHAPED tokens, as well as a key are needed to open a new lock for warehouses, garages, and office buildings. Each employee's tokens are individually marked. Dropped in the slot, as shown above, they reveal who used the door last.

New Coal Barge Corrugated to Give It Unusual Strength

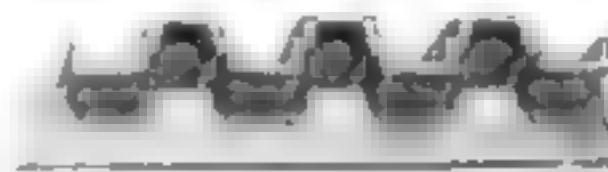


The + 200 ton coal barge was designed like a corrugated paper box in an effort to give it more than ordinary strength without increase of weight. Photo shows its bearing capabilities.

In designing a 130-foot, all-steel coal barge, recently launched by a New York shipbuilder, the principle that gives strength to a corrugated paper box was employed.

The new method, called "reverse channel" construction and combining unusual strength with minimum weight, was worked out by Johannes Kjekstad, welding engineer. Instead of pressing corrugations into the sides of the boat, or running a huge plate through a gigantic mill, the same effect was achieved by welding together standard steel channel beams with

their flanges facing alternately in opposite directions. Although the added surface increases resistance at high speeds, operation tests are said to have shown that at barge speeds the effect is negligible. In case of grounding or collision, the shell will have a tendency to stretch out, accordion-fashion, according to the makers.



Above, welding steel channel beams together to the barge. Left, cross-section of channel



EXPOSURE METER GIVES TIME FOR ENLARGEMENT OF PHOTO

AMATEUR photographers know the difficulty of judging the density of a film or plate negative and timing the exposure correctly for an enlargement. An electrical "enlargement exposure meter" has recently been placed on the market. The user holds it against the easel and presses a button, illuminating a small window. Then he turns a rheostat knob until the brightness of the window matches an adjoining area, illuminated only by light from the enlarging lantern. The correct exposure, corresponding to the knob setting, is then read from a table, and is given for six standard grades of enlarging paper.



CAP ON TUBE SPREADS SHAVING PASTE



AUTOMATIC SPEED SIGNAL FOR AUTO AND PLANE

A "signalling speedometer" has been invented by a Pasadena, Calif., architect automatically to warn motorists and aviators when they reach a predetermined speed, by giving an audible signal or lighting a lamp. The automobile model would be connected to the transmission, and would assist a driver to keep within legal speed limits. Adapted for airplane use, the device would operate from a venturi tube, a device that gages air speed. It would aid a pilot in judging when his plane has attained take-off speed.

For the convenience of those who use shaving creams of the non-lathering type, a special applicator has been invented to replace the standard cap on the tube. This new spreader cap applies the paste directly to the face; it is unnecessary to get the fingers greasy. With the cap slightly unscrewed, a gentle squeeze forces the desired amount of paste through a hole and onto the flat spreader. When the cap is screwed down tightly after use, it effectively seals the tube. By the use of this spreader, less time is required to shave.

Plane in Test Climbs at Forty-five Degree Angle

How steeply can an airplane climb? To find out, experimenters at a Berlin airport recently set up an inclined metal wire at a predetermined angle. Skimming near the ground in his high-powered monoplane, P. de Angeli, noted Italian pilot, zoomed directly behind the standard. The picture at the right shows one of his spectacular forty-five-degree zooms, with the tail of the machine barely clearing the ground. To perform the maneuver, the highest type of piloting was demanded.

At right, one-hand cigarette case holds and lights cigarette. Below, extended cigarette holder is lighted by cigarette lighter.



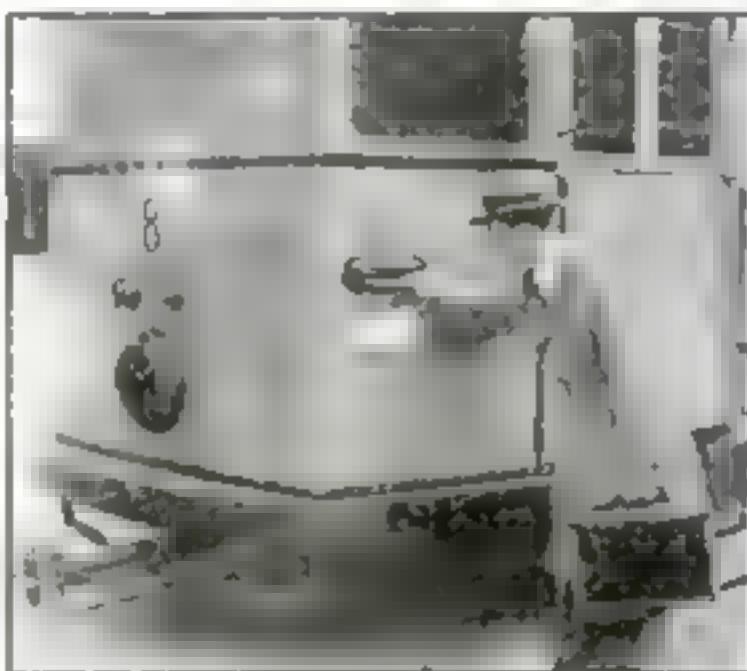
ONE-HAND CASE OFFERS AND LIGHTS CIGARETTE

A ONE-HAND pocket case that delivers lighted cigarettes is the latest aid for smokers. Invented by a San Francisco man, the new case holds nine cigarettes. The mechanism is operated entirely with one hand. A slight pull on the top of the case snaps on the lighter concealed at one side, and partially extends a cigarette. The smoker takes the cigarette between his lips, gives one strong draw and it is lighted. The lighter is extinguished by sliding a snuffer over the flame-opening. As a cigarette is extracted, a spring forces a new one into its place.



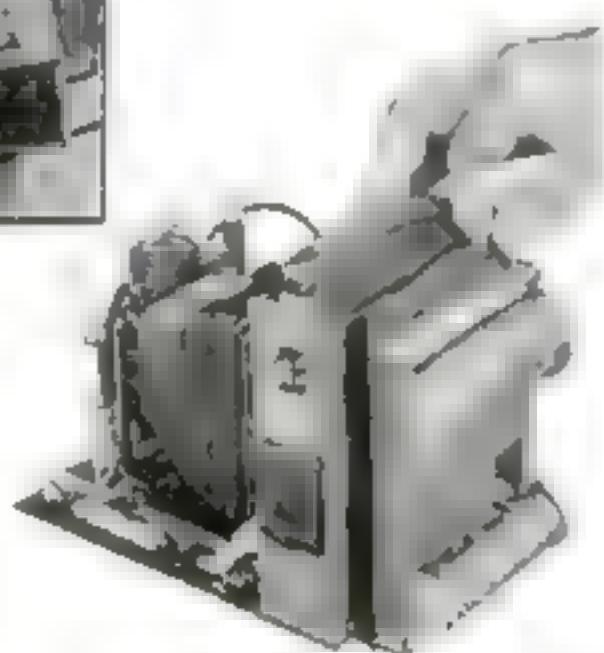
This powerful monoplane, flown by an Italian pilot, is able, as this picture shows, to climb at an angle of approximately forty-five degrees, as indicated by the wire near it.

STREET CAR LETTER BOX SPEEDS MAIL



As a convenience to the residents of Strausberg, Germany, letter boxes have been put on street cars.

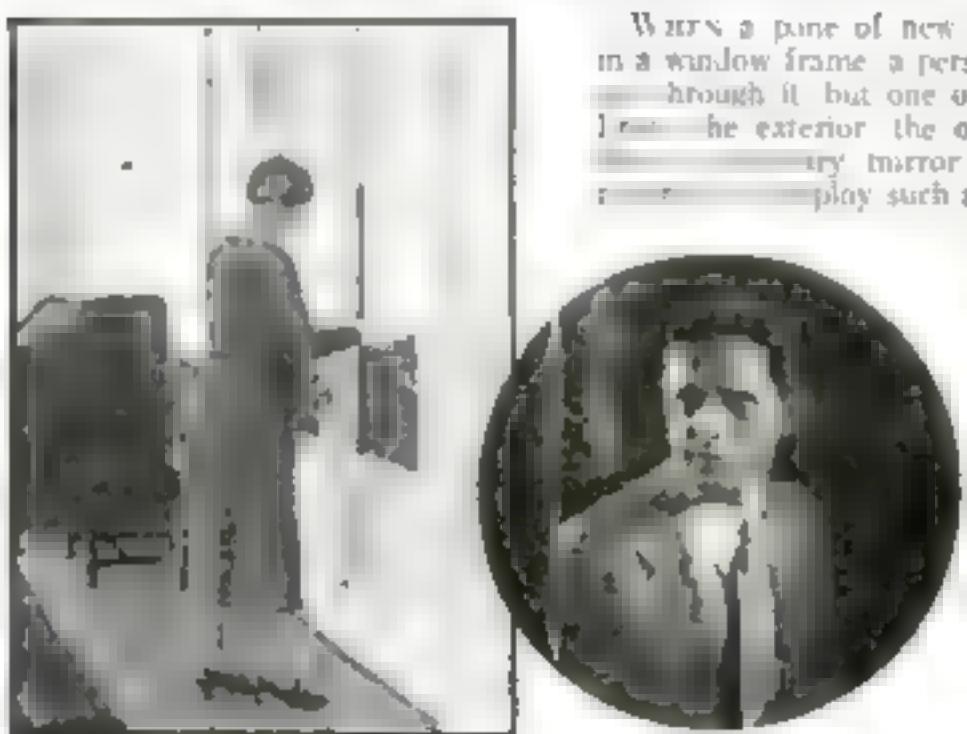
MAIL boxes on street cars have made their appearance in Strausberg, a little town near Berlin, Germany. Now residents may post their letters at any car stop if no other receptacle is near at hand. But it is not recorded whether any person has had the temerity to hail and stop a car for the sole purpose of getting his letter started for its destination.



NEW WINDOW GIVES ONE-WAY VISION

WHEN a pane of new material is mounted in a window frame a person on the inside can look through it but one outside cannot see in. Like the exterior the one-way pane resembles a mirror. Chicago police are employing such a pane to enable witnesses to identify criminal suspects without meeting them face to face. Banks and business offices also find use for the device.

Woman looking through the one-way window pane can see the man in circle, but he is unable to see her. Police are using the new pane to hide witnesses from prisoners they identify.



FILM CAN NOW BE USED WITH A PLATE CAMERA

EQUIPPED with a new adapter, a plate camera can use roll film. The device that accomplishes this fits upon the back of the camera in place of the plate holder and accommodates a spool of standard roll film. Since the film is arranged to lie exactly in the position formerly occupied by a plate, the regular focusing scale of the camera can be used. The change from plateholder to film adapter requires only a second or two.



RIGHT BUT RIGHT This coffee can is hot but only automatically seals itself tightly when closed, but it also releases exactly the right amount of coffee for one cup so that it can be operated without mistake by a blindfolded woman.



WATER COOLER AIR *A few weeks ago we had a water cooler installed in our office. The water was very cold and the air was very hot.*



STOPS SHIVERY CHILLS. Wring
keeps the heat in the human body and when it
touches a user and a cold window, it pre-
vents loss of body heat by radiation.

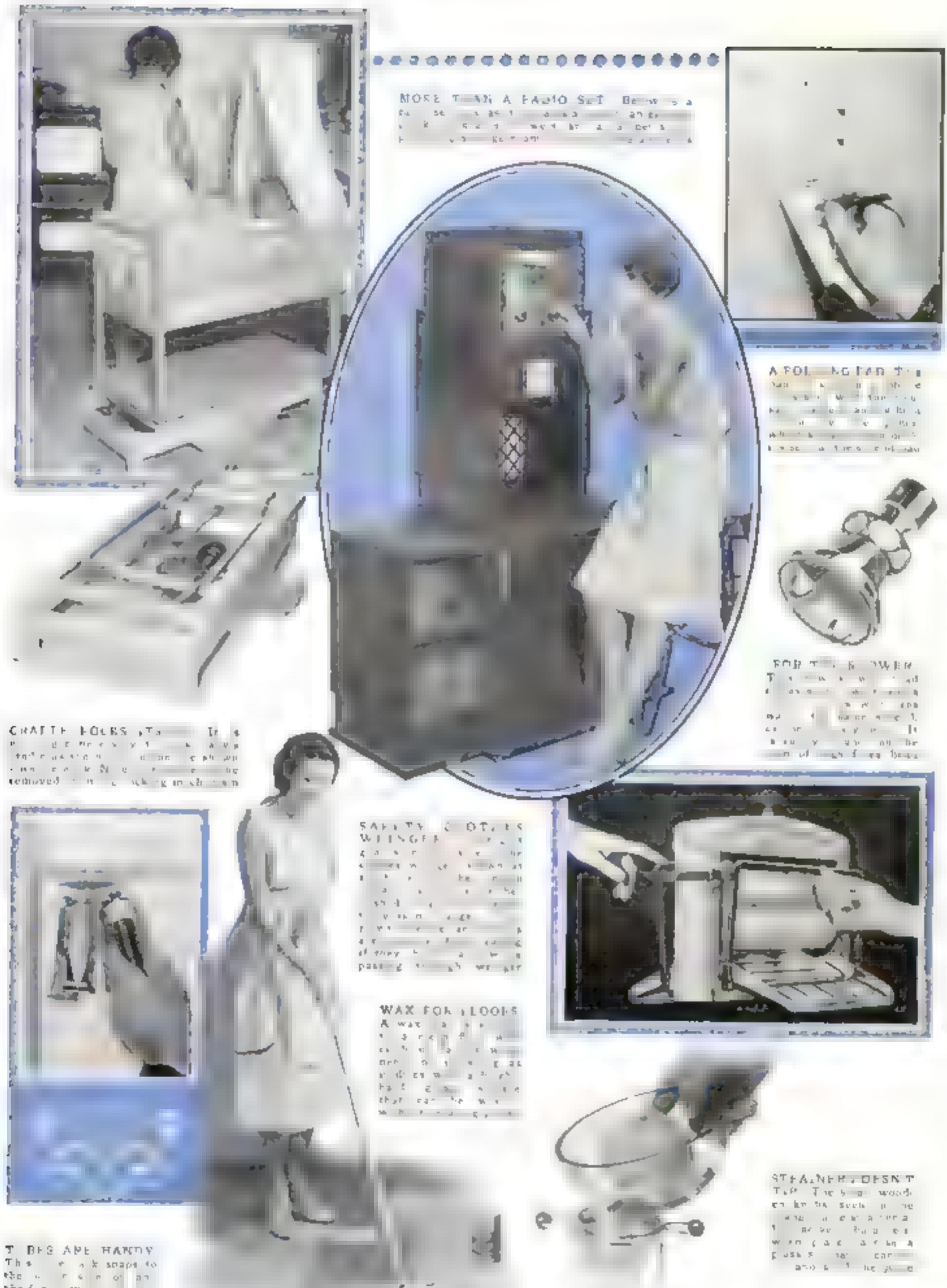


BUTTON CLEANS PAD Press the carbon side face of the micro-cleaner pad in a sheet of carbon until the message disappears. Pressing button cleans carbon and draws new sheet up.

GRAPEFRUIT CAN T SQUIRT
S. 400 - REASONABLE TO SERVE A
LOT OF SQUEEZE IN A GRAPEFRUIT BREAKFAST
CEREAL. LEMON BLOWS WITH A SQUIRT



GAS FRETZER CREAM N
S W B H T G
W 100 100 100 100 100
H 100 100 100 100 100
B 100 100 100 100 100
G 100 100 100 100 100

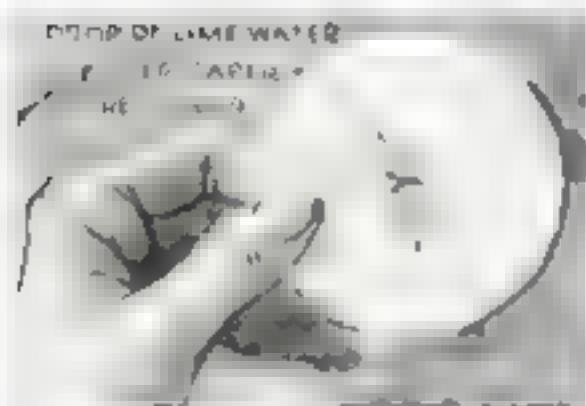


T BEGS ARE HANDED
The teacher asks the class to
show him a hand or a
piece of a work he has
done. The teacher asks
the student to show his
hand or the work he has
done.

NOVEMBER, 1932

59

1 Apparatus, below, consists of bottle filled with charcoal and cotton into which ink is poured. Through glass tube in cork, ink drips out clear, carbon having adsorbed all the coloring pigment



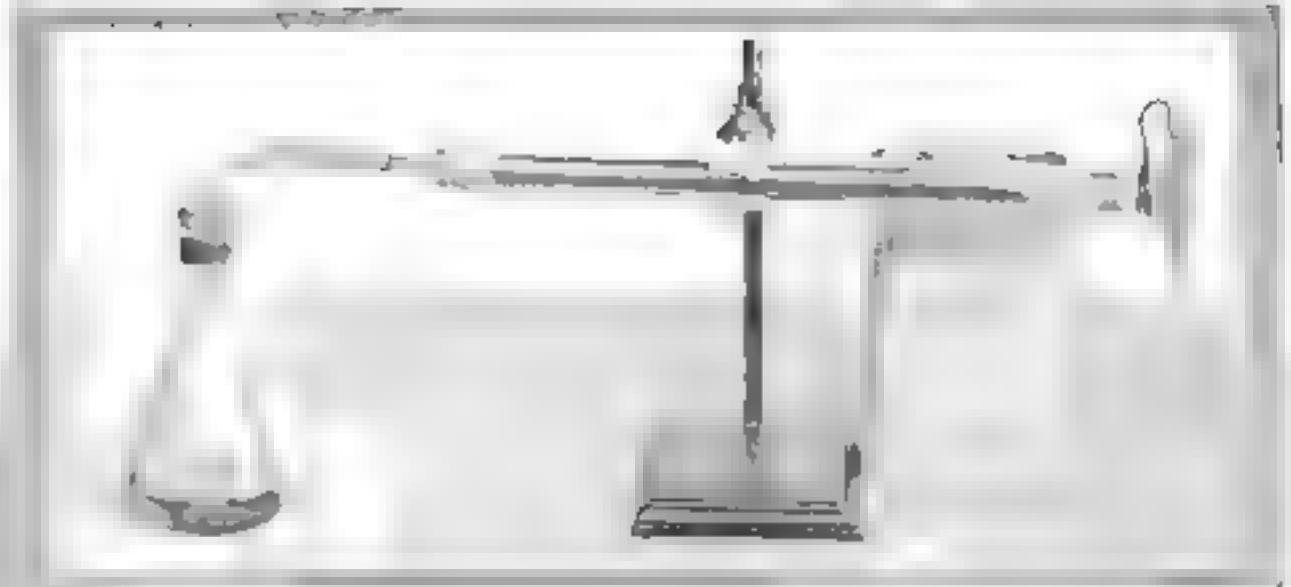
2 To show action of adsorption place drop of lime water on filter paper. Adjoining this place drop of phenolphthalein solution. After the drops spread into each other a red crescent will appear where the drops overlap

IF YOU had your choice between burnt toast and a diamond, you undoubtedly would choose the diamond. Chemically speaking, however, you would be getting carbon in either case. The burned, black portion of toast is carbon, while the diamond is carbon in a crystalline form. Do not be misled into believing that all crystalline forms of carbon are valuable for the only other crystalline form graphite is not highly prized and you will find it in every lead pencil and in every can of stove blacking.

Thus, you see, carbon may be found in vastly different forms. This fact will not surprise you when you realize that it constitutes more than two-thirds of the 300,000 known chemical compounds. So numerous, indeed, are the uses and properties of carbon, that the special name of Organic Chemistry has been given to the study of its compounds.

Although the forms of carbon are so numerous and differ so greatly in color, hardness, and density, all are identical chemically. Heated and placed in oxygen they burn with a vivid flame to form carbon dioxide gas. In fact, so readily does carbon combine with oxygen that under certain conditions it steals the oxygen from oxygen-containing substances called oxides.

With the simply arranged apparatus shown in Fig. 6, the amateur chemist can easily demonstrate this breaking down action of carbon on oxides. A mixture of



3 Hydrogen sulphide gas, generated in the flask by the action of acid on iron sulphide. Gas is passed through the long tube filled with charcoal, which adsorbs it as is proved when paper at end of filter tube shows no trace of black

Experiments with CARBON for the Home

By
**RAYMOND B.
WAILES**

black copper oxide and powdered charcoal is placed in the test tube and heated. The heated charcoal, combining with the oxygen, changes the copper oxide to copper and forms carbon dioxide gas. This gas can be recognized by the fact that if it is led through the outlet tube into a beaker containing clear lime water, it turns the lime solution cloudy. The free copper remains in the test tube as a bright powder. This removing of the oxygen from a compound is called "reduction," and the substance from which the oxygen has been removed is said to have been "reduced."

Another valuable property of carbon, and one that makes the gas mask possible, is its ability to remove noxious gases from the air by adsorption. Adsorption is the property of a solid that causes gases and other substances to cling to its surface. The extremely porous nature of carbon makes it particularly adsorptive. A good sample of charcoal is capable of adsorbing several hundred times its own volume of ammonia. In the manufacture of gas masks, an extremely porous form of charcoal made from fruit pits is used.

AND INTERESTING and instructive experiment showing the adsorptive properties of charcoal can be easily performed in the home laboratory. A glass or metal tube, filled with charcoal, is connected, by means of a cork and tubing, to a flask in which by the action of a dilute acid on iron sulphide, hydrogen sulphide gas is being generated.

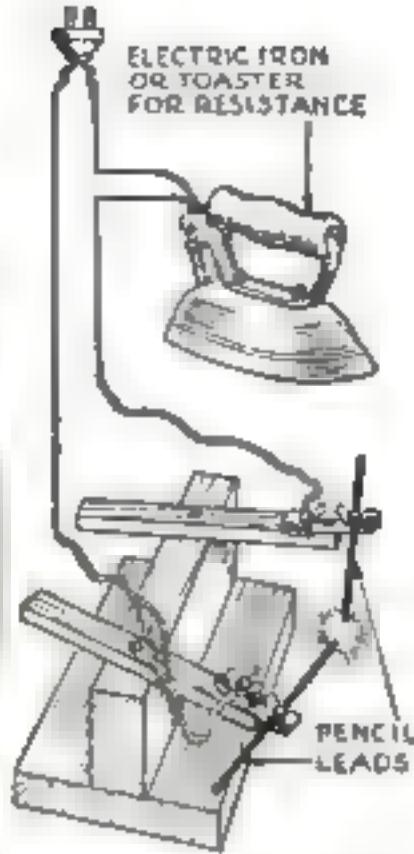
In experiments dealing with the sulphur compounds (P. S. M., Sept. '32, p. 50) it was found that hydrogen sulphide gas has a distinguishing rotten egg odor and that it can be definitely recognized by the fact that paper, moistened with either lead

acetate or copper sulphate, is colored when brought in contact with it. As in Fig. 3, lead acetate paper is placed at the outlet of the charcoal filter tube to detect even the slightest trace of the gas, but it remains colorless showing that the charcoal has effectively adsorbed the hydrogen sulphide.

ANOTHER experiment, showing graphically the action of adsorption, consists of allowing a drop of lime water to fall on filter paper or a piece of blotter. Adjoining the spot of water place a similar drop of phenolphthalein solution. This drop will spread into the first spot and some time after the two spots have spread into each other, a red crescent will appear where the two overlap. The lag between the visible overlapping of the two spots and the formation of the color is caused by the fact that the water in both solutions creeps through the fibers more rapidly than the chemicals which are adsorbed by the paper.

Phenolphthalein can be purchased in a alcohol solution for a few cents from any druggist and can be conveniently stored in a drooping bottle. Its real value lies in its ability to indicate the presence of a base or alkali, such as lime water or calcium hydroxide by changing to red or pink. Because of this property it is referred to as an "indicator."

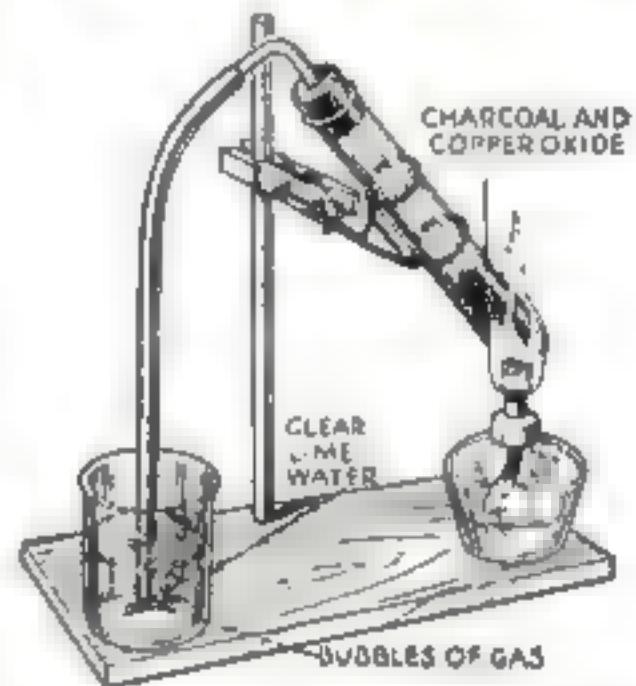
The same property that causes carbon to adsorb toxic gases makes it useful as a filter for removing coloring matter from substances. Commercially, bone-black, another form of carbon, is used in sugar refineries to remove the undesired color from sugar solutions. Fountain pen ink, diluted with water so that it is somewhat weakened in color, can be changed by the



4 Wiring diagram showing how to set up small arc lamp, illustrated at left. Strips of wood are fastened to block so they can be adjusted while clips hold ordinary pencil leads. When current is turned on, the leads will get hot, and if slightly separated will glow.



5 With ammonia water in flask, a wad of tissue paper is inserted and over this a spoonful of powdered charcoal is poured. As charcoal absorbs ammonia gas, the water in the beaker will rise through the tube connection, proving that the adsorption of gas by the charcoal has created a vacuum in the flask.



6 Black copper oxide and powdered charcoal are placed in test tube and heated. Hot charcoal combines with oxygen, changing oxide to copper, and forms carbon dioxide gas.

Chemist's Laboratory

home experimenter into a colorless liquid by filtering it through charcoal in the manner illustrated in Fig. 1. An olive bottle forms a neat funnel for this experiment.

IN ONE end place a cork fitted with a glass tube. Then place a wad of cotton in the bottom and fill the bottle with charcoal. Ink poured in at the top will drip from the outlet tube at the bottom in colorless solution. If the ink is greatly diluted, this experiment can be carried through by using an ordinary glass funnel fitted with filter paper containing charcoal.

As already pointed out, charcoal absorbs ammonia with great avidity. This can be shown by placing a tablespoonful of strong "ammonia" or ammonia water in a small flask or bottle fitted with a stopper and outlet tube as in Fig. 5. After allowing sufficient time for the ammonia gas given off by the ammonia water to displace the air in the bottle, drop in a wad of tissue paper and on it pour a tablespoonful of powdered charcoal. After quickly inserting the stopper, place the end of the outlet tube in a small beaker of water.

If all the connections are airtight and the ammonia water strong enough, the water in the beaker will be drawn up in the outlet tube showing that a vacuum is being formed inside the flask by the adsorption of the ammonia vapor by the charcoal. If the charcoal is heated and cooled in a stoppered bottle before the experiment, the rise of water in the tube will be more rapid. This same experiment can be repeated, using hydrogen sulphide gas to illustrate the removal of odors from the air by the use of charcoal. The tissue paper is used in this experiment to prevent the charcoal from coming in contact with the ammonia water.

Charcoal is also valuable as a filter for removing odors and tastes from water. Hydrogen sulphide water, unmistakable because of its characteristic odor, can be made odorless by filtering through charcoal. Similarly, the bitter taste imparted to water by dissolving a quinine tablet in it can be removed by a charcoal filter.

Sugar, when heated, first melts and chars to form caramel but on further heating changes into one of the purest forms of carbon. A striking experiment illustrating the preparation of charcoal from sugar can be performed by adding concentrated sulphuric acid to a strong solution of sugar and water. The sulphuric acid decomposes the sugar water to form carbon which flows forth from the container in a foamy pasty mass. Although wasteful of acid, the experiment is quite harmless providing the usual precautions are taken to keep the hands and clothing away from the acid.

JUST as oxygen combines with metals to form oxides, carbon reacts with metals to form carbides. Calcium, for instance, unites with carbon to form calcium carbide. Cast iron has carbon particles embedded in it and chemically combined with it. A small piece of cast iron when dissolved entirely in muriatic acid leaves behind black particles of carbon.

Lampblack, a form of soot like that given off when a kerosene lamp smokes, is practically pure carbon. The hydrogen in the oil burns but much of the carbon, because of a lack of oxygen, remains unburned and is deposited on any cold surface with which it comes in contact. Commercially, lampblack is used in the manufacture of paints and inks.

Although obtainable from natural deposits, graphite is also produced artificially

by heating anthracite coal in an electric furnace capable of producing an extremely high temperature. The graphite crystals appear as smooth plates or scales and it is this smoothness that makes graphite valuable as a lubricant. Artificial graphite can also be produced in the form of a fine powder that will remain suspended in water or oil.

Like all forms of carbon, graphite is practically infusible, making it useful as a material for crucibles used in the melting of metals. Like the diamond, graphite burns only at extremely high temperatures.

For use in pencil leads, graphite is mixed with clay in varying amounts depending on the hardness desired.

Graphite differs from the other forms of carbon in that it is an excellent conductor of electricity. Thus it finds important application in the electro-chemical industries where it is used as electrodes. Also, since carbon in any form will not melt, graphite forms an excellent material for the electrodes of an arc lamp.

Pencil leads can be used by the home experimenter in a small experimental arc lamp. The house lighting circuit, connected with some electrical appliance such as a flat iron, toaster, or heater, is used as the current supply. (*Continued on page 93*)



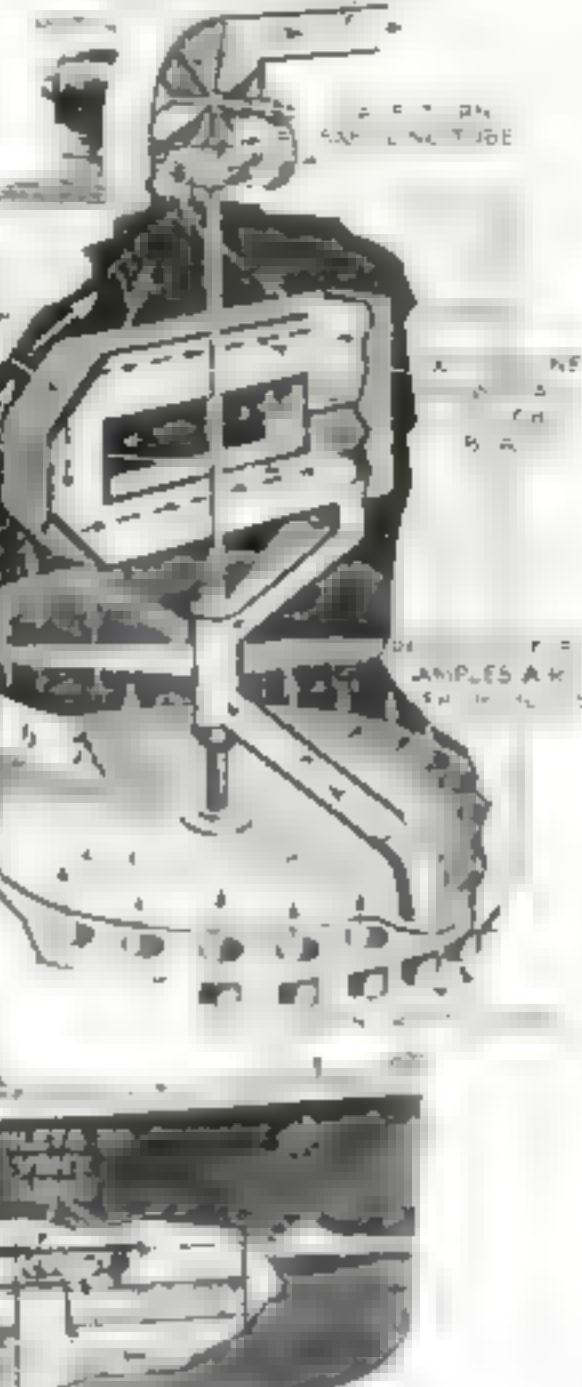
Electric Eye sounds Fire Alarm and Locates Blaze on Ship

DISASTERS such as the recent burning at sea of the French passenger steamship *Georges-Philippe*, with the loss of dozens of lives, may be averted in future by an automatic fire alarm system perfected especially for marine use. Not only does this apparatus sound an alarm when the first wisp of smoke anywhere in the ship indicates a fire, but it reveals the exact location of the fire in time to prevent it from gaining headway.

The heart of the apparatus is a photoelectric cell or electric eye within a "sampling chamber," through which a suction fan draws air from the holds of the vessel. A beam of light from a small lamp is directed with mirrors upon a circuitous course through the chamber until it falls upon the sensitive cell. So long as the beam is uninterrupted, nothing happens. When smoke in the air cuts off the light beam, however, the photo-electric cell

FINDS A FIRE AND SIGNALS WARNING. Designed especially for use on ships, the device can locate the exact point where a blaze starts.

SMOKES UNNOTICED AND SMOKE GOES THROUGH VENT TUBES



operates an electric relay and sounds the alarm. Even the merest trace of smoke reduces the intensity of the light beam and operates the alarm.

Vent tubes radiate from the fire detector to each of the ship's holds where a fire might conceivably start. Samples of air are drawn in turn from each tube through an ingenious "selector disk" bearing a revolving collector, as shown in the diagram. The disk also carries a numbered ring, the numbers corresponding to the individual holds. When an alarm sounds, the disk automatically stops, and the location of the fire is read at once through a window in the side of the detector. The officer on the bridge then orders the fire-fighters into action, or operates mechanical extinguishers if the ship is provided with them.

Cash Prize WINNERS *in our August Heroes of Science Contest*

Here Are the Names of Twenty-Nine Whose Skill and Application Brought Them Cash Rewards in Our Big Picture Cutting Contest in August Issue

FIRST PRIZE \$500

Charles Land, Hicksville, N. Y.

SECOND PRIZE \$100

H. J. Brockman
Baltimore, Md.

THIRD PRIZE \$50

M. J. Langley
Chicago, Ill.

SIX \$25 PRIZES

V. Brantboover, Brackenridge, Pa.
Frank P. Conrad, Toledo, Ohio.
C. Muchuchen, Woodside, N. Y.
P. Sabatini, Brooklyn, N. Y.
J. F. Smolen, Bronx, N. Y. C.
Glen McWilliams, Van Dyke, Mich.

TWENTY \$10 PRIZES

R. Albrecht, Jr., Cincinnati, Ohio
J. M. Bosanic, Milwaukee, Wisc.
S. Chemney, Cleveland, Ohio
D. S. Cookingham, Rhinebeck, N. Y.
J. A. Davis, St. Helena, Calif.
W. F. Drunk, Pittsburgh, Pa.
C. Gray, Brooklyn, N. Y.
M. C. Hicks, Chicago, Ill.
A. G. Kalmbach, Grand Rapids, Mich.
G. Marshall, Toronto, Canada.
H. A. McDonald, Louisville, Ohio.
L. M. Mullers, Nashville, Tenn.
R. F. Purdy, Raton, New Mexico.
V. E. Phasey, Fort Meade, Md.
P. Sapossnick, Brooklyn, N. Y.
Laura Shrum, Pottstown, Pa.
J. A. Vaughan, Belleville, N. J.
Howard Watkins, Loonie, S. Dak.
G. T. Welch, Edgewood, R. I.
W. A. Werneke, New York City.

New Radio Tube Has Three Uses

Changing the Grid Hook-up in Amplifier

Type 89 Changes Work It Does in Set

THREE complete grids, each with its own separate connection, give a remarkable radio tube, the new type 89, the ability to change its characteristics as a chameleon changes its colors.

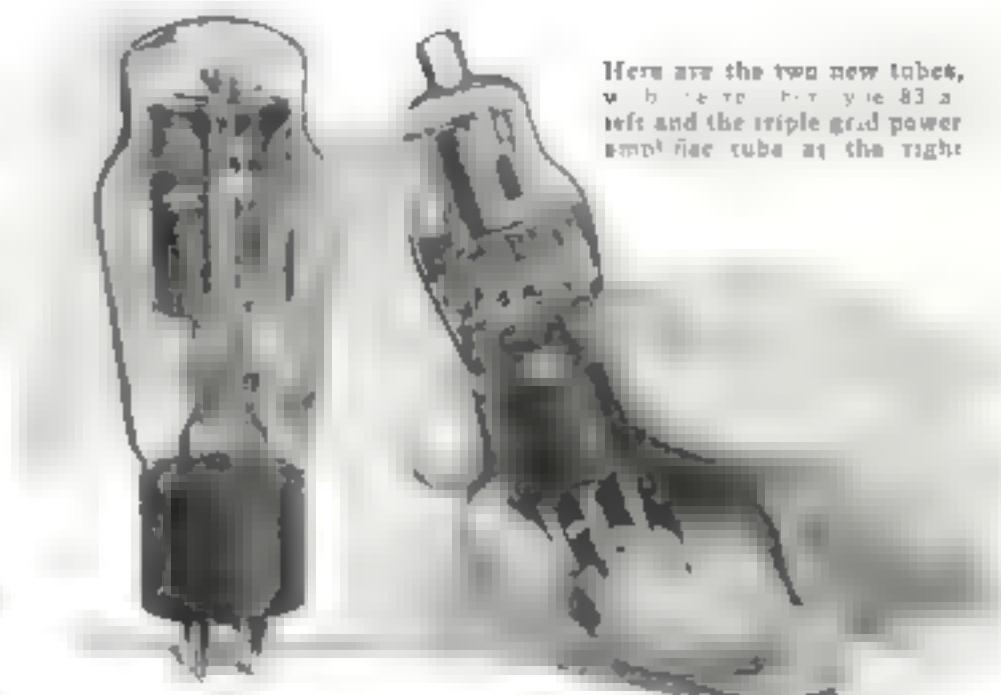
When a tube of low amplification factor is required, type 89, with its grids connected a certain way, becomes such a tube. Hook the grids another way and you get tremendous amplifying power. A third combination makes the tube suitable for use in the latest push-push output circuit that operates without C bias.

Another new tube, the type 83, full wave mercury vapor rectifier is designed to handle exceptionally heavy and variable loads. It has the astonishing output of a quarter of an ampere at high voltage and also will handle instantaneous overloads up to .8 of an ampere. Compare these new tubes with the best obtainable only a few years ago and the advances that have been made in the vacuum tube become evident. The old 216B, rectifier, for example, which supplied B current to many of the early models, could handle a load of only .06 of an ampere at a fraction of the voltage easily carried by the new type 83.

The new triple grid power amplifier type 89 is particularly adapted to automobile service and other mobile sets where no electric light current is available. It uses a heater cathode rated at 6.3 volts and .04 of an ampere, just .01 of an ampere more than other automobile types such as the 236, 237, and 238. Like them, it will stand any battery voltage fluctuation ordinarily encountered in automobile operation.

Picture at upper right shows both the new tubes, rectifier, type 83, being at the left. Because of the need for separate connections to all three grids, the type 89 has a cap connection in addition to the six prongs on the base. That makes seven separate connections, which is the greatest number that has ever been used on any tube for broadcast reception.

In construction, the new triple grid tube is, perhaps, simpler than some of the previously introduced screen grid types. Photo upper left shows an 89 dissected so



Here are the two new tubes, the rectifier type 83 at left and the triple grid power amplifier tube at the right.

At left type 89, taken apart so triple grid construction is visible. At center is tiny cathode with inset grid outside it, but pulled up to show construction. Plate is cut and folded back to give clear view of the two other grids.

that the triple grid construction is laid bare. At the center is the tiny cathode. Outside that is the inner, or number one, grid, pulled up out of place to show the construction more clearly. The plate, a cylinder of carbonized sheet metal, has been slit and a portion folded back to expose numbers two and three ends in the new tube.

The diagram at bottom of page shows how the various elements of the tube are connected to the prongs and cap.

When it is desired to use type 89 triple grid tube as an ordinary amplifier in the audio stage preceding the final or power output stage, grids two and three are hooked to the plate terminal, and the tube is then, in effect, a regular three

element tube. The cathode emits electrons that are controlled by the number one grid as they pass through on their way to grids two and three and the plate, all acting as one positive or plate element.

If it is desired to use this tube as a power pentode of somewhat similar characteristics to type 238, then grid number three is wired directly to the plate and grids one and two connected together, form the control grid.

Under these conditions, the tube in the last stage has a power output of 1.5 watts as compared with only .3 of a watt when used in the simple three element way.

To use type 89 in the push-push (class B amplification) circuit a single grid number three is wired directly to the plate and grids one and two connected together, form the control grid.

As the tube is designed for use in sets that are subjected to considerable jarring and vibration, mechanical rigidity is an important item. Extra bracing for the assembled elements is obtained in a novel manner. The top of the bulb is domed and the top insulator, of sheet mica, is made in the form of a cross. Its size is such that the ends of the cross just touch the inside walls of the glass dome.

Type 89 should be of especial interest to radio experimenters and students of radio theory because the number of grids, each with a separate connection, permit all sorts of test circuits to be worked out.

The new rectifier tube is of the full wave, mercury vapor type. One of its distinguishing features is the low, and virtually constant, voltage drop. Within its rated load limits, the voltage lost in the functioning of the tube is only fifteen. That means the voltage delivered by the tube will always be just fifteen volts less than the voltage applied to it by the transformer. This holds good whether the tube is working on a heavy or a light load.

A steady, non-fluctuating B supply voltage is of great value in operating the new push-push circuit. The push-push hookup draws many times the amount of current on a strong signal as on a weak one. In fact the current flow in a push-push circuit continually fluctuates even when the volume level is kept constant.

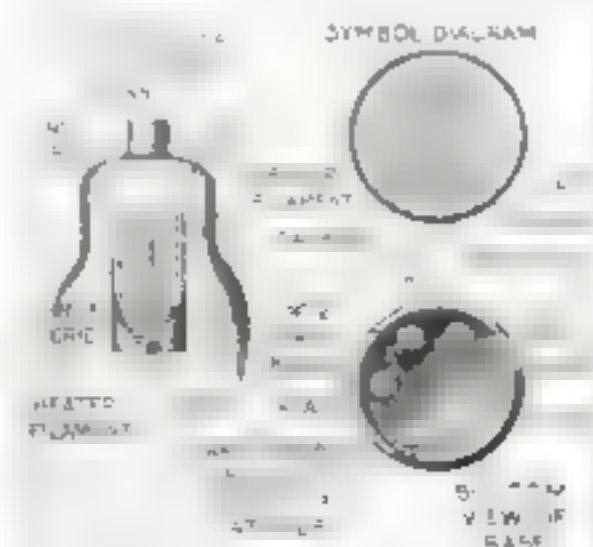
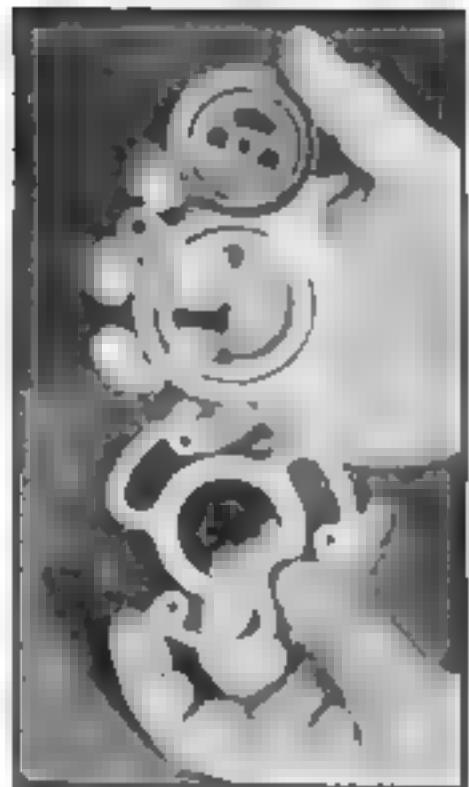


Diagram of type 89 showing how the various elements are connected to the prongs and cap.

Trailing Trouble in Your Loudspeaker



Three typical loudspeaker spiders which are used to support the voice coil so it can vibrate freely back and forth.

WOBBLING back and forth some eighteen million times for every hour of use, your radio loudspeaker gets a pretty tough deal. No other part of the radio receiving equipment has to stand such terrific mechanical punishment. It is no wonder, therefore, that a radio loudspeaker occasionally breaks down under the strain of so much vibration.

There are many makes and sizes of radio loudspeakers, but they are alike in basic design and they all have similar troubles.

No matter what the shape of the frame or the general appearance of any modern loudspeaker, it is almost sure to be of the dynamic type. That means it contains a powerful electro-magnet, the core of which is circular in section. At the apex of the paper or treated fabric cone, there is a tiny coil of wire wound on a short paper or fibre cylinder. This cylinder is large enough to fit over the end of the magnet core without touching. Various means are employed to hold the small coil centered over the core and yet permit it to move freely back and forth.

The base or edge of the cone always is held to the front supporting ring by means of a rim of soft leather or other equally flexible material. Theoretically, the cone is supposed to vibrate as a unit. In practice it usually does this but vibrations in the cone material also are set up.

The only variation from this general construction is found in some recently introduced light-weight dynamic speakers for use with automobile and small mantel-piece type sets. Some of these are fitted with a permanent magnet in place of the electro-magnet.

Among the possible troubles to which the dynamic speaker is subject are burned out field coil, burned out voice coil, loose connections, broken spider, loose voice coil, loose diaphragm, cracked or split diaphragm, and a warped or off-center voice coil.

This is a rather imposing list of things that can happen. Fortunately, most of these possible troubles are quite rare.

When your loudspeaker gets sick the first job is to diagnose the ailment. Taking the troubles in the order named, if the field coil burns out, the speaker will still continue to operate, but the volume will drop to such a low level that you can hardly hear it, even with the set volume control turned full on. In fact the only reason you get any sound at all is because of the slight residual magnetism left in the pole piece.

A sure test for field coil operation is to hold the end of a screw driver near the pole piece. It should be strongly attracted to it. If it is not, then either the field coil is burned out or there is a broken connection somewhere in the wires that supply current to the coil.

A burned out voice coil completely silences the speaker. The simplest test is to connect a dry cell and a pair of headphones in series with the coil and listen for the click-clack as you make and break the circuit. If you don't get it, the coil is broken at some point.

A loose connection in the speaker leads results in intermittent operation or in excessively noisy and irregular volume.

A broken spider usually causes chattering noises that are most pronounced at some particular tone frequency. However, if the spider is broken in such a way that the voice coil is allowed to shift out of its central position and so rub against the pole piece, the tone will sound muffled and there may be continuous scratching noises.

A loose voice coil always spoils loudspeaker results and the symptoms will depend on the nature of the looseness. If, for example, the coil and spider have come loose from the cone, a beulam of chattering will be produced. If it is only partially loose, the chattering is likely to occur only on some particular musical note.

Looseness at the front edge of the diaphragm or an opened seam or crack in the diaphragm itself, always produces chattering noises. The seat of the trouble often can be located by placing the finger gently on different points of the diaphragm while it is in operation.

You can always detect a warped or off-center voice coil by the method illustrated in the picture at upper left. There should be sufficient clearance between the pole piece and the inside of the coil to slip a piece of writing paper into the crack and move it all around the pole piece.

There are, of course, other troubles that affect dynamic speakers which have been added to older sets as independent units. For instance, in the so-called A. C. type dynamic speaker, which has its own rectifier system for supplying its field current, the dry, or tube type rectifier, may go bad. If that happens, the speaker will act as though it had a burned out field coil.

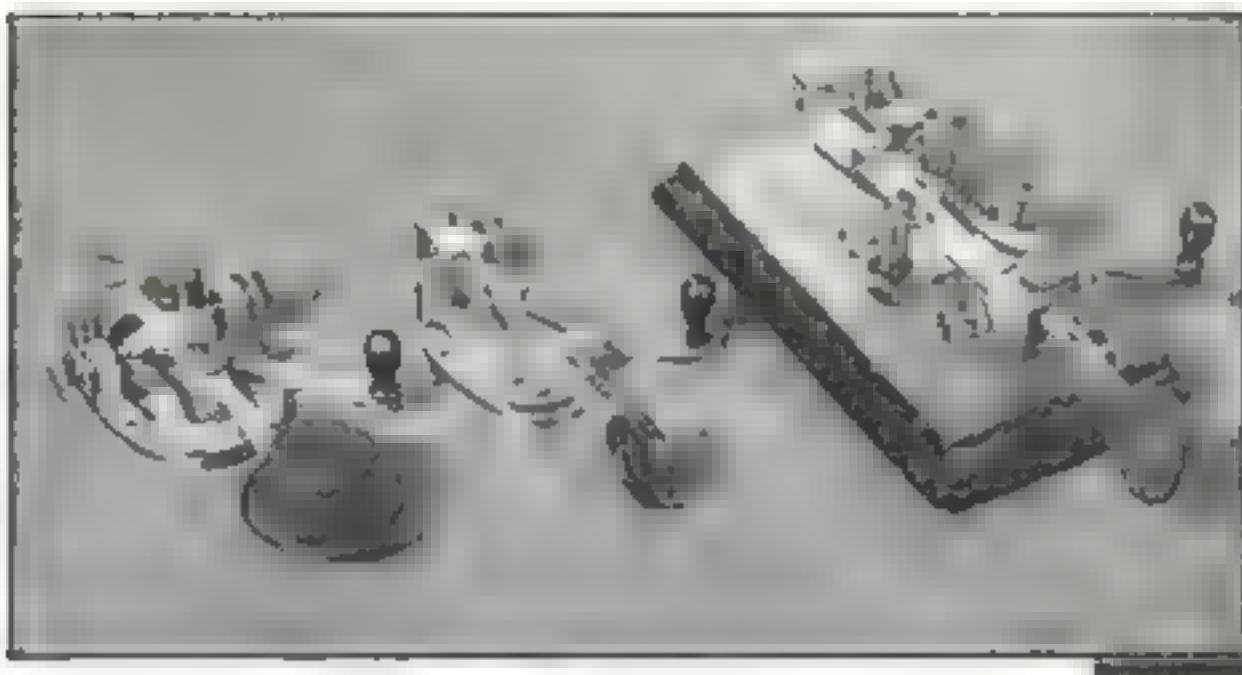
The cure for any dynamic speaker trouble is to repair or replace the part. It is now possible to obtain any of the separate parts for all popular makes of loudspeakers, either from the original manufacturer or from smaller concerns specializing in this work. Picture, upper right, shows several different types of spiders readily obtainable.

It is not practical to repair a spider as this part has to be made with extreme accuracy as otherwise the voice coil will not be held central.



LOUDSPEAKER COILS

At left, the voice coil consisting of a layer of fine wire on cardboard. Right, coil which magnetizes pole piece.



Three types of keys short-wave operators may use. At left, regulation up and down type; in the center, side swiper and at right the bug, that makes dots automatically.

Photo at left
1 - 2 - 3 - 4
5 - 6 - 7 -
8 - 9 - 0 -
dot from a
cramping of
your muscles



How to get Good Code "FIST"

Efforts at Speed Spoil Amateur's Work in Spite of Type of Key Used

ABILITY to send clean-cut, readable code, a good "fist," is the goal of every amateur radio operator. As you listen in, however, on the amateur wave bands, you will hear the International Morse Code distorted, mutilated, and garbled in every conceivable way. There is the fellow who invariably rattles off five dots for every H, makes his Vs sound like STs, and his Ls and Fs so they might be almost anything.

Some of the erratic sending is the result of plain laziness or carelessness, but most poor key work can be blamed on the wholly erroneous idea that speed is the badge of the expert.

The beginner, finding that the sending which was good enough to get by on his amateur operator's license examination sounds slow compared with that of old-timers on the air, immediately tries to speed up and pound the brass to the tune of twenty or twenty-five words a minute. Then trouble starts. His dots come in irregular bunches, his spacing goes to pieces, and his arm and wrist get tired and cramped.

The next step is to blame the key and to experiment with other types such as the "side swiper" and the "bug." Unfortunately, this only makes matters worse unless he gets back to first principles and realizes that there is no substitute for laboriously developed manual skill. No matter what kind of a sending key you obtain, you must learn how to use it.

Although side swiper and bug keys are

usually thought of in connection with fast sending, they are in fact excellent for slow and medium speeds. Once you learn how, you can send almost perfect code, the steady, medium speed kind that is so easily read, with either a side swiper or a bug. And your wrist will not get as tired as it does with the regular up-and-down motion, sending key.

The picture at upper left shows examples of the three common types of sending keys for radio or land line telegraphy. At the left is a plain key. Pressing down the button closes the contact. Releasing the button breaks contact. The middle key is a side swiper. Moving the lever either way from the center position makes contact. You can make a dot or a dash by moving the button sideways in either direction.

A row of dots are made by wobbling the lever from one side to the other and as it obviously takes half as many motions to make a row of dots this way as it does to make the same number of dots with a regular key, the sideswiper permits twice the speed with the same amount of motion. What is still more important to the amateur is that it permits a reasonable speed with a relatively slow hand motion that does not tire the wrist of operator.

The key at the right is a bug. Several varieties are on the market, but they all work on the same principle. Pulling the vertical finger piece to the left with the

By
John Carr



Bug sender with pen pointing to spring wire that vibrates to make dots at contact

index finger closes a contact to make a dash. Pushing the finger piece to the right with a brisk motion produces a string of dots in rapid succession. The speed with which the dots are made can be regulated by slightly moving a weight which is attached to the end of the spring.

Ousting Harmonics

MOST radio experimenters are familiar with the wave trap and the manner in which it is used to cut out unwanted stations. Many beginners at radio transmission

do not know, however, that the same scheme can be applied to outgoing waves as well as to incoming ones. The Government requires that amateur transmission take place as nearly as practical on a single frequency.

Often the transmitter, even when carefully tuned according to the correct method, will radiate an appreciable amount of energy on a harmonic of the wave to which it is tuned. Push-pull type transmitters, such as the one recently described in this magazine, are not likely to radiate on even harmonics because the push-pull effect balances out that type of radiation. One or more wave traps can be used to suppress this radiation. A method applicable to the single wire fed Hertz type antenna is shown in the diagram at the bottom of the page. The trap coil need only be coupled to the antenna feed wire.

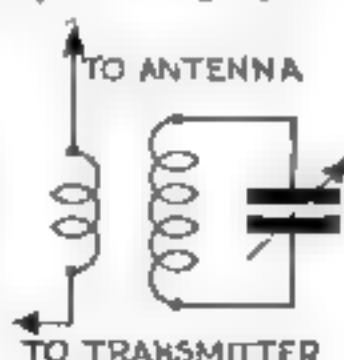
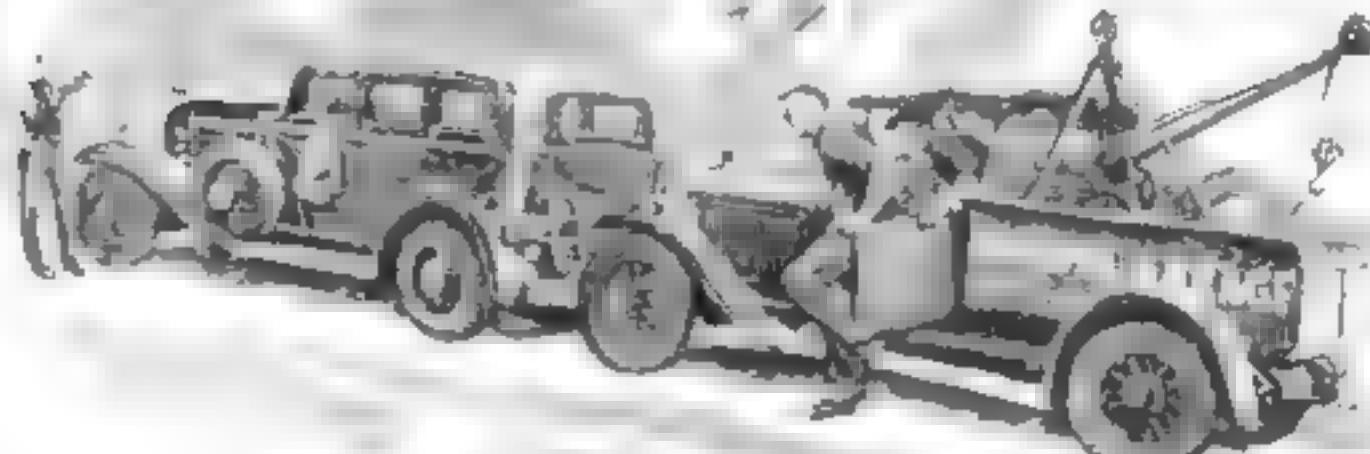


Diagram showing the way to trap out harmonics and get a single frequency transmitting wave on a single wire fed Hertz type antenna

"Anything we can do for you?"
Gus asked the man who was
fussing over a stalled car.
"I'll say there is," was the
disgusted reply. "I was half
way up this hill when the
motor sputtered and died."



Gus tells

How to Inspect a Stalled Motor

GUS WILSON slid into the driver's seat of the wrecking car, touched the starter button, and was about to drive out of the Model Garage when Joe Clark, his partner, arrived for the day's work.

"Ride over to the freight station with me," Gus called in answer to Joe's greeting. "I've got to pick up a load of tires and I'll need some help. The kid will look after the place till we get back."

Near the station, the wrecker rounded a blind curve. Gus turned his head in response to a sudden nudge from Joe's elbow.

"Look," directed Joe, pointing to a small man standing beside the opened hood of a car parked half way up the steep hill directly ahead of them. "Somebody's got into trouble bright and early this morning. Scratching his head about it, too. Guess he doesn't know much about motors."

Gus took his foot off the gas and brought the wrecker to a stop a few feet behind the parked car.

"Anything we can do for you?" he inquired.

"I'll say there is," came the disgusted reply. "I was half way up this confounded hill when my fool motor began coughing and sneezing and finally sputtered and died. And I'll be hanged if I can find out what's wrong."

"Out of gas?" Gus asked as he stepped on the starter and pulled the choke all the way out.

"Nepe, I thought of that, but the tank's almost two-thirds full."

"Hm. Plenty of gas and the gasoline line isn't plugged up either from the looks of this," Gus said, pointing to a steady trickle coming from the carburetor he had flooded by turning the motor over with choke out.

"Generally there are three things that'll

make a motor die in action," Gus stated. "No gas, a clogged gas line, and bum ignition. Since it isn't the first two, your trouble probably is the ignition."

"But I had a new set of wires put in about three months ago," the man protested.

Gus grinned broadly. "The wiring's not the only thing that can go wrong with an ignition system. Ever hear of the breaker arm?" He unsnapped the clip on the distributor cap and pointed to a curved arm in the base of the distributor. "There's one place to look when a motor dies from bad sparking."

Interested, the driver leaned over the fender and peered into the distributor as Gus moved the breaker arm back and forth to illustrate its action.

"You see," Gus explained, "when the distributor shaft turns, the little cam attached to the shaft opens and closes these contacts. Now we'll turn on the ignition and see what happens."

Gus again opened and closed the breaker and this time grinned with satisfaction.

"There's the clue to your troubles, he

reported. "The breaker points are so badly chewed up and burned they don't make good contact and they are badly now and then just as they are opening."

"That means two things," Gus went on to explain. "First, the breaker points need redressing, second, your condenser's probably gone haywire. The burned points are what caused some of your trouble, but ten to one a bum condenser caused the contacts to burn in the first place. Been having any trouble with the motor lately?"

"Come to think of it, I have," admitted the man. "Had trouble starting only this morning, but after several tries I finally got it going and didn't think anything more about it. Maybe the condenser was on the blink then."

"Sounds like it," agreed Gus, selecting a screw driver and some small wrenches from the large tool box that formed a part of the wrecker's running board. "First we'll take out those breaker points and try and redress them. While we're doing that, Joe'll drive back to the garage and pick up a new condenser."

Gus was busily rubbing the contacts back and forth over a small oilstone when Joe Clark returned with the new part.

"As I was saying," repeated Gus after examining the condenser, "you can touch up these points without even taking them out if you want to. Just hold a small file between them and pull the file back and forth. That'll do the trick if they aren't chewed up too much. I always like to get them out in the open, though, where I can look them over."

With both garage men working, it wasn't many minutes before the points were back in the distributor, adjusted to the right spacing, and connected into the new condenser.

Gus laid his tools on the running board and slid into the (Continued on page 93)

GUS says:

When applying the brakes in wet weather, don't throw out the clutch until you've almost come to a stop; the motor will prevent the brakes from grabbing too quickly. Never apply the brakes suddenly and don't follow the car in front of you too closely. Be especially careful driving over wooden bridges or on wood block pavements.

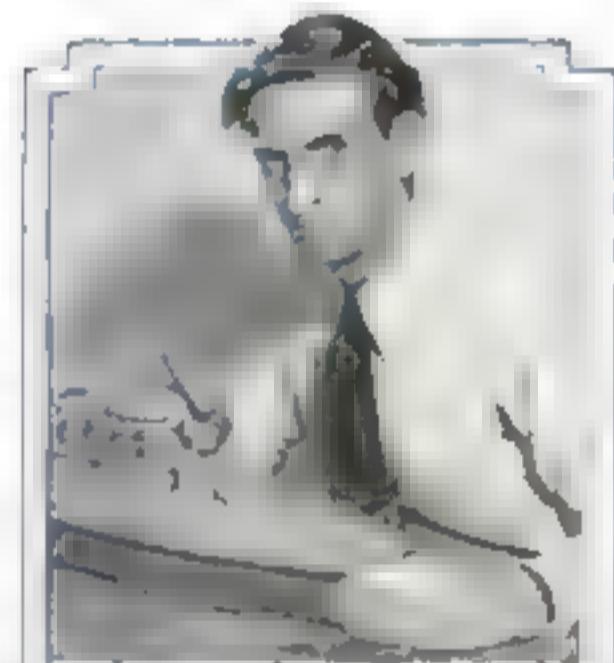


MODEL MAKING : HOME WORKSHOP CHEMISTRY : THE SHIPSHAPE HOME

A Matchless New Model for You to Build
The Battleship TEXAS

HERE are the blueprints for a 3-foot model of the battleship Texas. It is a copy of the famous vessel which was the first American battleship to be built after the Civil War. It is a copy of the famous vessel which was the first American battleship to be built after the Civil War.

It is a copy of the famous vessel which was the first American battleship to be built after the Civil War. It is a copy of the famous vessel which was the first American battleship to be built after the Civil War.

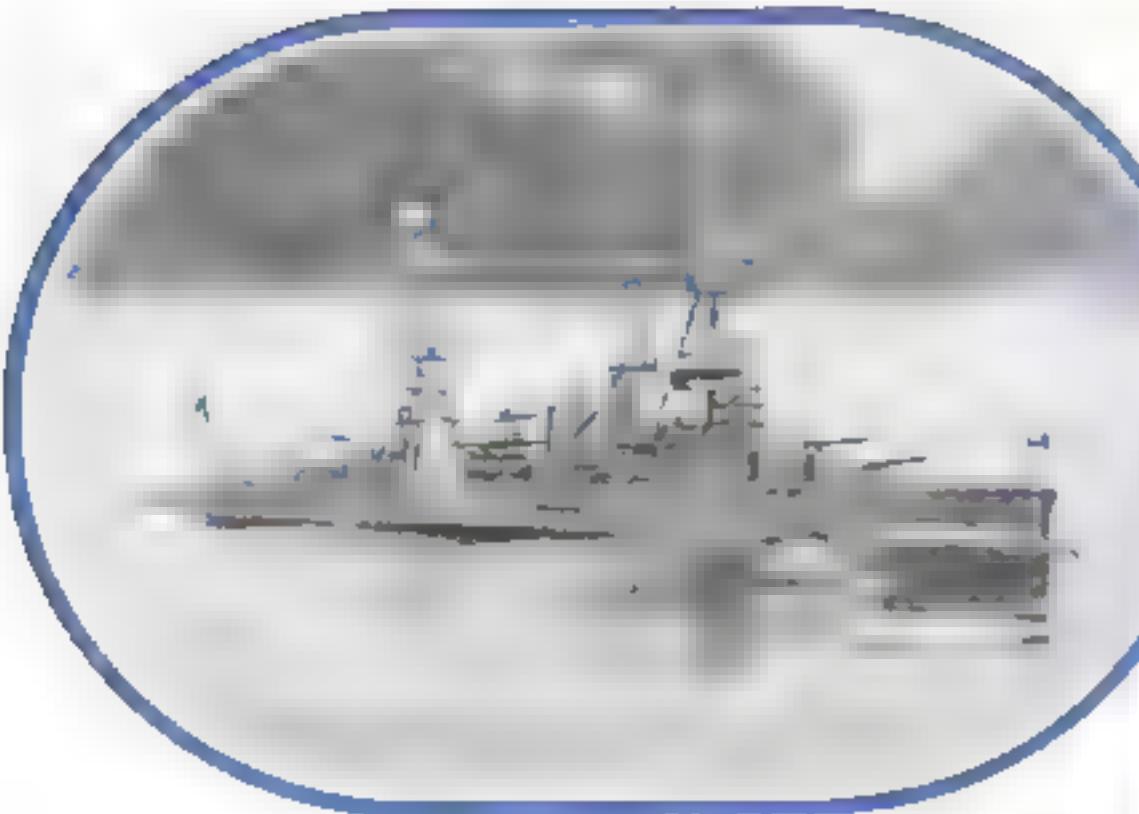


Captain
E. Armitage McCann
gives plans for making
a 3-foot model of the

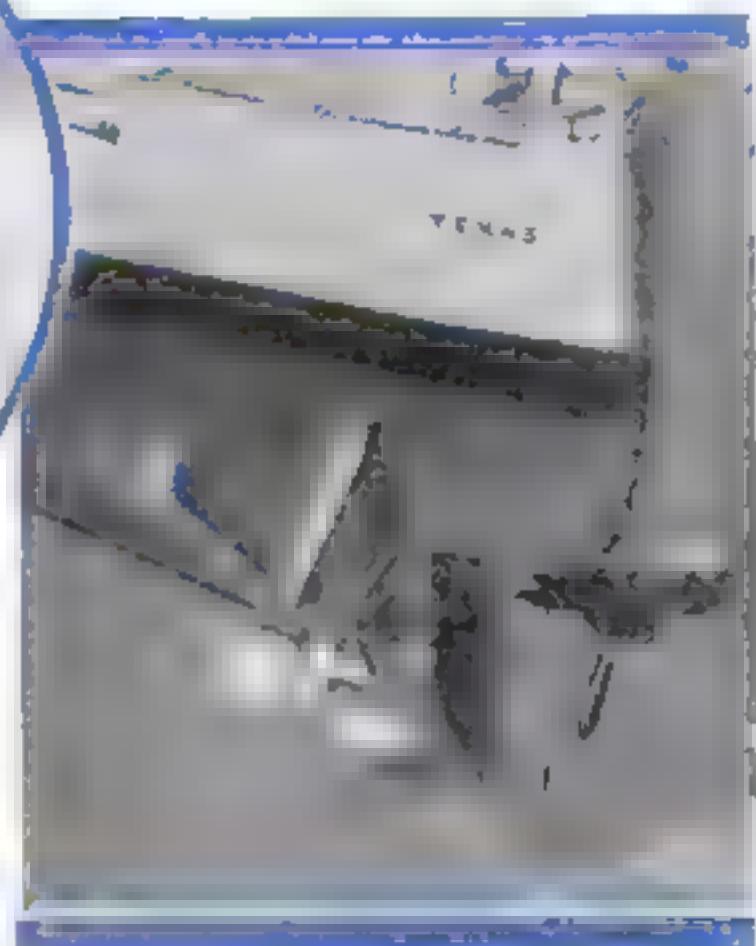
**Flagship of the
Atlantic Fleet**



WORKS IN PROGRESS
BY
THE
U.S.
NAVY



The model under way, plowing through a calm sea. Without anything to give away her size, she looks for all the world like her big sister. Below: A close up of the stern showing the rudder and two screws. Compare with the drawings on the next page.



is so new and so important that the Navy Department will not furnish any plans; hence this model had to be worked out without official aid, but the lines and details may be taken as essentially correct. The bridge work is so complicated that has been simplified to retain the correct effect, and many minor details, such as mushroom ventilators, have been omitted.

Though the model is specifically the Texas, it would serve almost as well for the U.S.S. New York. Both were built from the same plans, the former at Newport News and the latter at the New York Navy Yard. The differences are minor.

The Texas carries the ranking Admiral's flag and is so powerful that she could be miles out of sight of the coast yet blow a city to bits in short order. Her great 14-in. guns, 53 ft long, will pierce armor plate so far away that it cannot be seen aboard. She has enough electric power to light a small city.

The real ship has a displacement tonnage of 27,000 tons and an allowance of 1,315 men, and she cost about \$11,000,000. Her length on the water line is 565 ft., and the over-all length is 573 ft. The beam, without blisters, is 100 ft. On the scale of 1/16 in. equals 1 ft., this gives us a model almost 3 ft. long and 6 1/2 in. wide.

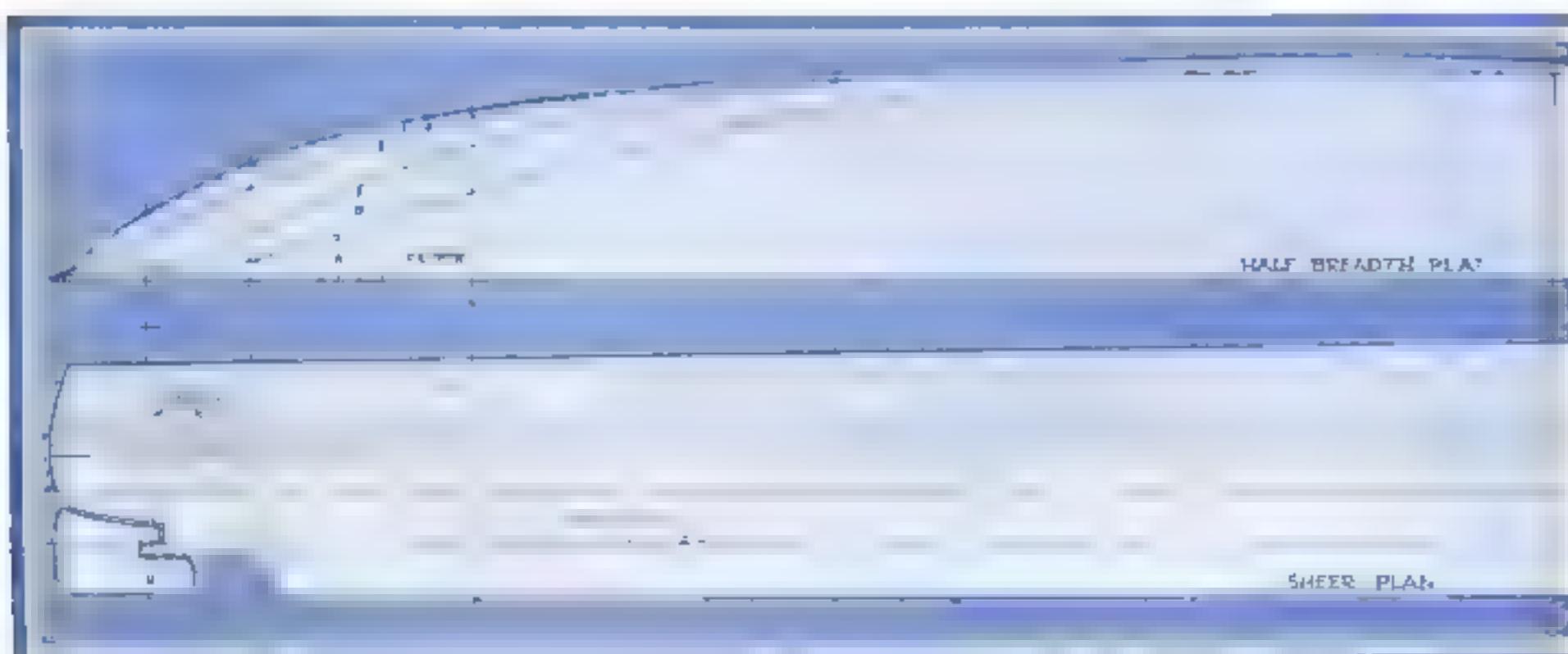
It will be seen on the sheet given that the hull has been divided vertically into water lines *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *I*, *J*, *K*, *L*, *M*, *N*, *O*, *P*, *Q*, *R*, *S*, *T*, *U*, *V*, *W*, *X*, *Y*, *Z*. These are 1/16 in. thick and 4 1/2 in. wide. On each piece of board (white or sugar pine or other soft wood) mark the corresponding outline from the half-breadth plan. This can be done by pinning the plan on the wood with two pieces of carbon tissue, back to back, between the wood and the paper, then cutting the plan down the center line and turning it over to get the other half. I prefer, however, to take off the lines on a piece of tracing paper and turn it over to get the other half. Draw the center line right round the board, as well as the construction lines Nos. 1 to 10.

With a compass saw, jig saw, or band saw, cut the wood to these shapes. Then, as the model is to be hollow, jig-saw out the center of lists *B*, *C*, and *D* to about 1/2 in. thick, leaving plenty at the ends. It is better also to leave in crossbars somewhere about the middle to prevent spreading until the hull has been glued up. Glue these lists together, except the top list, being careful that all the construction lines correspond. This is essential.

The top list *E* must be planed down to

1/4 in. thick at the stern. It is straight from end to end with no sheer, but a camber, or curve, of 1/8 in. from the edges to the midship line can be given. This, however, is a nuisance on a working model, so I left the surface flat. If you wish to add this camber, have it rise above the line shown on the drawings. Next mark on the wood the deck outline and draw the center and cross construction lines.

Screw this top list temporarily in place and proceed to shave the sides of the hull to match cardboard or tin templates made from the lines of the body plan. It will be noted that the widths given on the half-breadth plan do not correspond throughout with the widths on the body plan at that position; that is, because the lists have to be left wide enough to cut the extreme width, whatever it happens to come. Thus *D* is bigger amidships at the bottom



The hull with the power plant installed. The motor was taken from an old automobile horn, and the small but efficient storage battery is homemade

than the top, and *B* bigger at the top than the bottom.

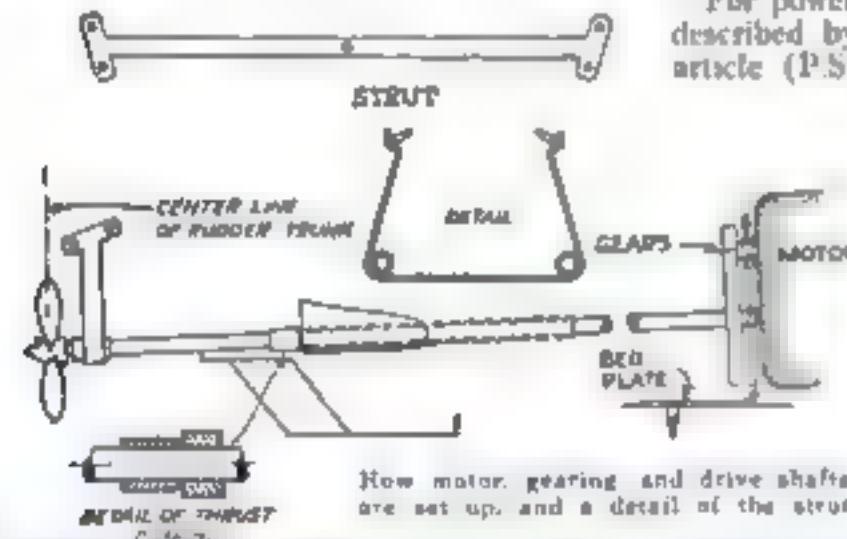
These ships, as modernized, have in addition to the hull proper what are called "blisters"—vacant inclosed spaces built onto the hull below the water line as additional protection from torpedoes. They are about 4 ft wide amidships, tapering from the water

line to the turn of the bilge and from about line No. 3 to No. 8. As they are ugly and not an integral part of the ship, they have been omitted.

Note that the stem is quite sharp until near the bottom where it has a "bulb" or roundness which flows into the body of the hull.

The body plan gives the shape the hull is first to be made. The upper part then has to be cut to represent the top edges of the armor plate and the casemates for the guns. The lowest cut-in is $\frac{3}{4}$ in. down from the deck, extends from line 3 to the bridge wing, and is $1/16$ in. deep at the middle, tapering to the ends. Above that the three recesses for the casemates are cut $\frac{1}{4}$ in. down. At there is a cut-in $\frac{5}{16}$ in. down from the bridge wing to the foremost casemate a full $1/16$ in. deep.

Having shaped the outside, remove the deck piece and, if it is to be a working



model, shave down the inside as thin as possible, but leave the bottom list intact as a stiffener and platform for the machinery. Some of the waste wood from the deck pieces may well be cut away from underneath. If preferred, the entire hull can be hollowed out and a thin deck laid.

Cut away the cross struts and put in a deck beam at each end of the opening.

The next thing to do is to install the power, if you intend to make a working model rather than merely a scale model for exhibition purposes. As there is plenty of room, any type of drive can be used—clockwork, steam, or electric. The average model maker will find the last to be the most satisfactory. I was advised by Mark A. Cooper, of Rome, Ga., who gave me some valuable suggestions, to try a motor from an automobile horn, and got one for a few cents. This works quite well, but I think a high-grade motor made for the purpose would be even better.

For power I built a storage battery as described by Mr. Cooper in a previous article (P.S.M., June '31, p. 108). This was made from standard size battery plates sawed in four, with two positive and three negative plates in each of the three cells. It is $3\frac{1}{2}$ by 3 by $2\frac{1}{2}$ in. high, weighs 3 lb., and drives the motor under full load for about an hour.

The motor of whatever type, must be fastened to a plate of stiff

metal, the bottom of which is turned up and drilled so that it can be screwed to the bottom of the vessel to form a stand. If the motor is at all heavy, it should also have a leg fastened to the back end. Through this plate a hole is drilled through which the motor shaft may project. To find the height of this shaft it will first be necessary to adjust the propeller shafts.

The vessel has twin screws or propellers of about $1\frac{1}{2}$ in. diameter. The shafts are $\frac{1}{4}$ in. brass rod about 16 in. long. For the shaft tubes, two pieces of brass tubing about 4 in. long and of a diameter to fit easily on the shafts are required. First cut the double strut to the shape shown; that is, to screw to the raised part of the keel, extend horizontally $\frac{3}{4}$ in., then turn upward to screw to the hull about $1\frac{1}{2}$ in. up, ending in cross flanges for that purpose. Cut a $5/16$ -in. piece off the tube and solder it into the head of the screw for a bearing. Put the propeller on the shaft, reeve the shaft through the bearing, and temporarily fasten the strut so that the center of the blades will be in line with the line of the rudder post, previously marked.

Before you can do this holes will have to be drilled in the hull through which to pass the shafts. It is best to make the holes amply large and then, when the tubes are finally in position, to wedge them and fill in with plastic material. Cut another $\frac{1}{4}$ in. off each tube, reeve them on the shafts, then place the remainder of the tubes and reeve them through the hull.

In the next article the installation of the motor will be described, and we shall begin to add the details to the hull.

THE HULL LINES

These three $1\frac{1}{2}$ x $1\frac{1}{2}$ in. half breadth plan and the sheer plan being read right across the two pages—show the shape of the hull, which is to be built up of five boards, each $1\frac{1}{2}$ in. thick.

HALF BREADTH PLAN



SMALL MACHINE ROLLS ON TWO CASTERS



Moving a small motor-driven saw

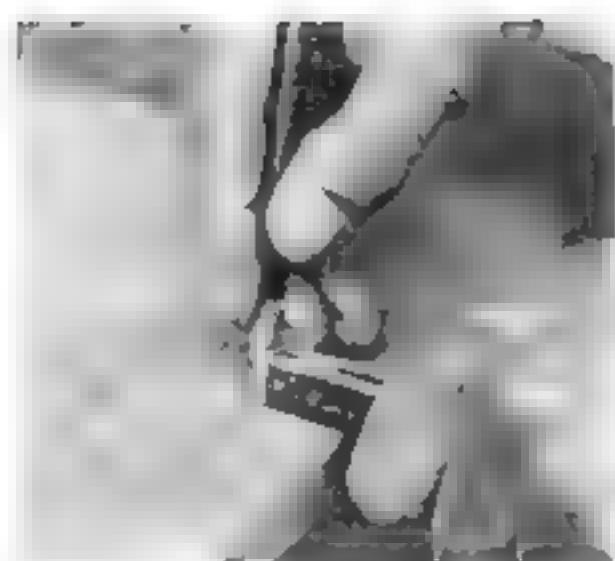


With this type of skid, a small home workshop machine will not shift while it is being used

wheel casters for this purpose, especially on a cement floor. To equip a machine with this type of caster, make two wooden skids as shown and bore a hole near one end of each skid to insert the caster. If a bit is used which will allow the casters to fit snugly, no fastening will be required. Then attach the skids to the stand.

Equipped in this way, the saw table shown and similar machines can be moved about merely by inserting a strong wooden bar through the openings in the upper part of the stand and lifting one end from the floor. The illustration also shows a cover for the motor. It is essential to leave this open on the end opposite the pulley to allow for a circulation of air through the motor. The cover may be removed by first unloosening the pulley, which takes only a minute.—JOSEPH J. LUKOWITZ

HALF aviation gasoline and half naphtha is a good mixture for cigarette lighters. The naphtha assures a quick light, and the gasoline retards the evaporation of the more expensive fuel.—K. M.



POCKETKNIFE DOES DUTY AS MARKING GAGE

ORDINARY saw-and-hammer repair jobs often require more tools than we take along, and one of these is likely to be a marking gage. In a pinch, a pocketknife makes an excellent substitute. The point of the pencil—or of a nail used as an emergency scriber—rests snugly in one of the blade hinge grooves, while the body of the knife is held as shown. The line is marked at the desired distance from the edge by sliding the thumb nail along the material, the pencil being held in place with the other hand. A carpenter will often gage a line merely by holding his rule in the same manner as the knife and keeping his pencil against the end of the rule, but that is more difficult.—F. W. B.

WOODEN TOOL STRETCHES WEBBING AND WIRE

FOR most upholstery work it is necessary to use a webbing stretcher. The one illustrated below, which is a copy of a tool more than 75 years old, is easy to use and gives such great leverage that the webbing can be drawn as tight as a drum. It is made from a piece of 1-in. hardwood 15 in. long. A hole $\frac{1}{4}$ in. wide and 3 in. long is cut through the center of the thick part, and the edges are sloped back for $\frac{1}{2}$ in. A triangular locking piece is then made that fits loosely into this notch on either side. One edge of the webbing is tacked securely on the frame. The webbing is then doubled, the doubled portion is passed through the hole, and the triangular piece inserted in the fold. The stretcher is held vertical and close to the frame, then pulled with one hand towards the operator. The tacking is done with the other hand, and the webbing is cut off, bent over, and nailed again if extra strength is required.

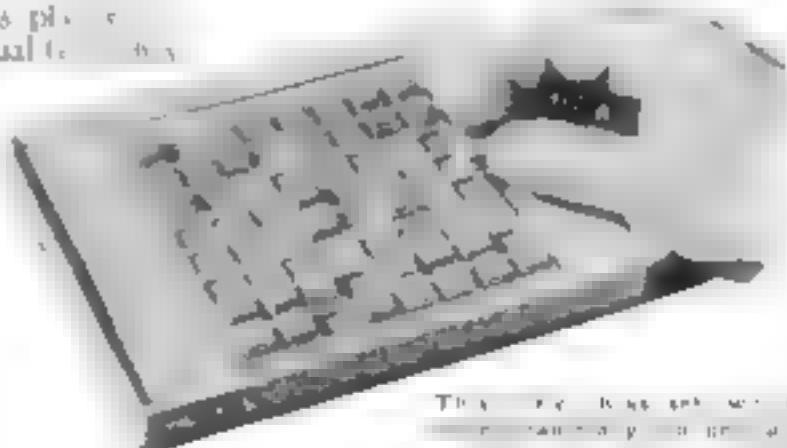
This tool is also very useful in stretching wire. One of the photographs shows a piece of clothesline wire being stretched tightly along a garage wall as a support for a row of sweet pea vines.—H. CALDWELL



A homemade stretcher in which webbing or wire is held by a wedge. It gives great leverage. At right: Using it to stretch wire.

A CHESS SET FOR INTERRUPTED GAMES

IN THE manufacturing plant where I am employed there are chess players over the building, but the actual time they can devote to a game is fifteen minutes each day. To provide an inexpensive type of board so that a game can be continued from day to day without the pieces becoming disarranged, I designed the outfit illustrated. Balsa wood such as is used in model airplanes provides the material for making the strips which divide the board into squares and also the blocks which represent the chessmen. The various blocks are identified by sticking on them paper symbols cut out from the chess problems published in a Sunday newspaper.



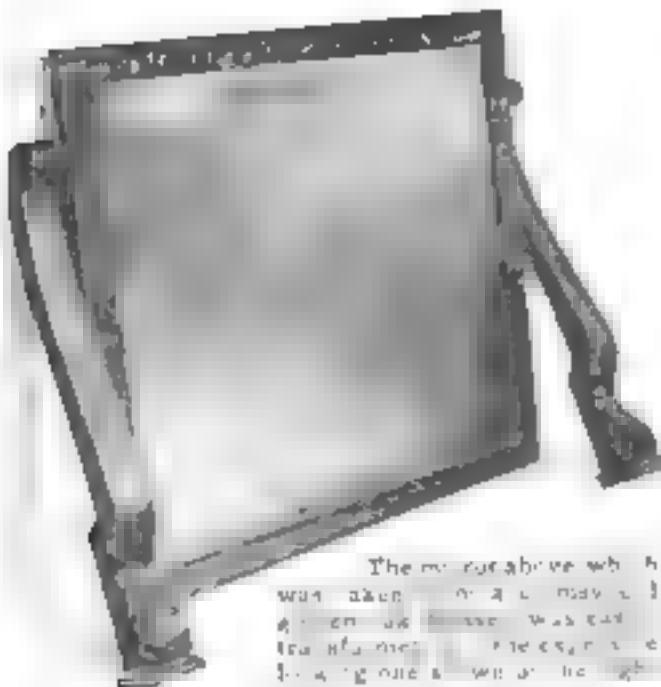
The chess board and pieces. It is made from balsa wood strips, costs but a trifle to make.

Each of us has two or three of these boards and we keep correspondence games going on with men or women on other floors, besides a daily game with somebody on our own floor.—A. M. SMYTH

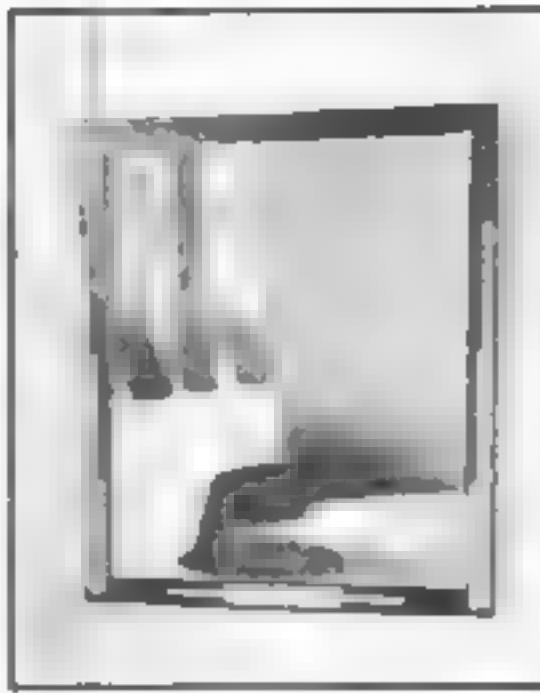
TEMPORARY ADHESIVE LEAVES NO TRACE

A USEFUL adhesive wax for temporary purposes can be prepared by adding a teaspoonful of Canada balsam to one ounce of melted beeswax, stir together, pour into a shallow flat tray, and, just before the wax hardens, cut it into inch square blocks. The wax is used by pinching a small lump off the block and working it in the fingers till it gets soft. The softened wax is then placed between the two surfaces which are intended to adhere and they are pressed firmly together. In this way objects weighing up to a pound may be stuck to a glass window for display. The wax will strip off without leaving a trace.—DOUGLAS LEECHMAN

Modern Mirror Made from an Old Golden Oak Cast-Off



The mirror above which was taken in a living room, was cut from an old dresser door.



THERE is no end to what can be done in modernizing old furniture. Every attic will yield pieces that can be magically transformed. The mirror from a discarded golden oak dresser, for example, can be converted easily into a piece that is as

up-to-date and smart looking as anything you can buy in a furniture store.

If you have such a dresser in the attic or can obtain one for a song, as is often possible, take off the mirror, sandpaper the frame, and then prepare trimming

pieces to ornament the sidepieces and bottom as shown in the second of the accompanying illustrations. These strips are $\frac{1}{2}$ in. square, the longest one on each side being about three quarters the length of the mirror frame. The ends of the strips are given a finished appearance by beveling them off at an angle of 45 deg. Before fastening on the trimming pieces with glue and fine brads, remove the glass from the frame so there will be no danger of breaking it.

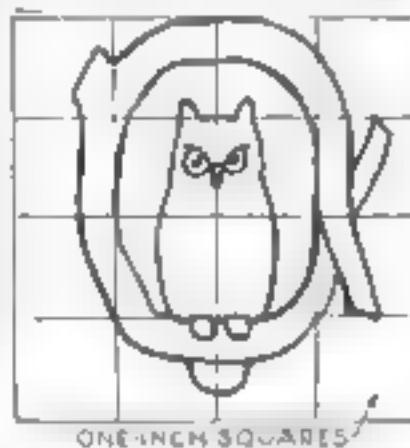
Give the old woodwork two coats of black brushing lacquer and the ornamental strips one coat of shellac and one of gold bronze, or use any color scheme suitable to the room in which the mirror is to be hung. Screw two eyes in the back of the frame and hang the mirror with heavy silk cord. I used a black cord about $\frac{1}{8}$ in. in diameter with a wire running through it, which I obtained at a ten-cent store. Small triangular pieces of wood painted either black or gold are fastened to loops at the upper ends of the cords to hide the hooks from which the two black cords are supported.—CHARLES H. ALDEN.

NOVEL JIG-SAWED WINDOW SHADE PULLS

This ornamental little pull for a window shade is made in the form of an owl sitting on a curved branch. To prepare the pattern, divide a 4-in. square into 1-in. squares; then draw the lines of the pattern from point to point across the squares as shown in the small diagram appearing below.

The wood used should be thin but not brittle. Thin plywood such as is sold for making jig-saw puzzles is especially good. Transfer the lines of the pattern to the wood, cut out the shape, and trim away the space around the owl and inside the curved branch.

Enamel or lacquer the branch very dark brown on both sides, and the owl a medium shade of brown. Of course, the branch will not show across the back of the owl, so carry the medium brown right down to form an unbroken area the shape of the owl's back.



A new use for your jig saw—making ornamental shade pulls.



Make the owl's eyes yellow with black centers, and its feet a shade lighter brown than its body. Decorative pulls are usually made in sets.—HAZEL F. SHOWALTER.

IMITATION PLATING FOR BRASS AND COPPER

MANY an amateur radio operator wishes his coils were a shiny silver instead of dull copper. Here is a process that can be applied right on the spot: Place 2 oz. of nitric acid in a 4-oz. bottle and add about $\frac{1}{2}$ oz. of mercury. When the mercury has gone into solution, add enough water to fill the bottle. Apply this solution to the coils—or, for that matter, to any brass or copper surface—and rub it in well with a rag or stiff brush. Then polish with a dry, absorbent cloth and go over the surface with a colorless lacquer. Unless the lacquer is applied, the surface will not remain bright.—WALLACE H. McCAY.



LONG HOOKS FORM NEAT SHELF BRACKETS

LARGE square screw hooks of the type shown make neat brackets for narrow shelves and may be moved easily should occasion demand. The hooks are placed about 3 in. from either end of the shelf and extend out from the wall about 2 in. for a shelf 3 in. wide. This width is sufficient for small cans of paint, spools of wire, and similar home workshop supplies. Two holes are drilled in the underside of the shelf to receive the ends of the hooks. The position of these holes is marked directly from the hooks by setting the shelf in position and tapping it sharply with a hammer.—DANIEL REYNOLDS.

OUR BLUEPRINTS—*A Gold Mine of Ideas*

WHEN you are about to start a new undertaking in your home workshop—it doesn't matter whether it is something mentioned in the current issue or not—see if the subject is on our list of blueprints (page 90). If it is, send for the blueprints, because they will save your time and insure your success. And if you are in doubt as to what to make next, consult that list for suggestions.

You will quickly discover it to be a gold mine of ideas.

A more complete list is given in our blueprint folder, which contains a brief description of all the projects. It can be had for the asking, provided you inclose a self-addressed and stamped envelope.

Reprints of our best model making article are also available for 25 cents each. They are indicated on the lists by the letter "R."

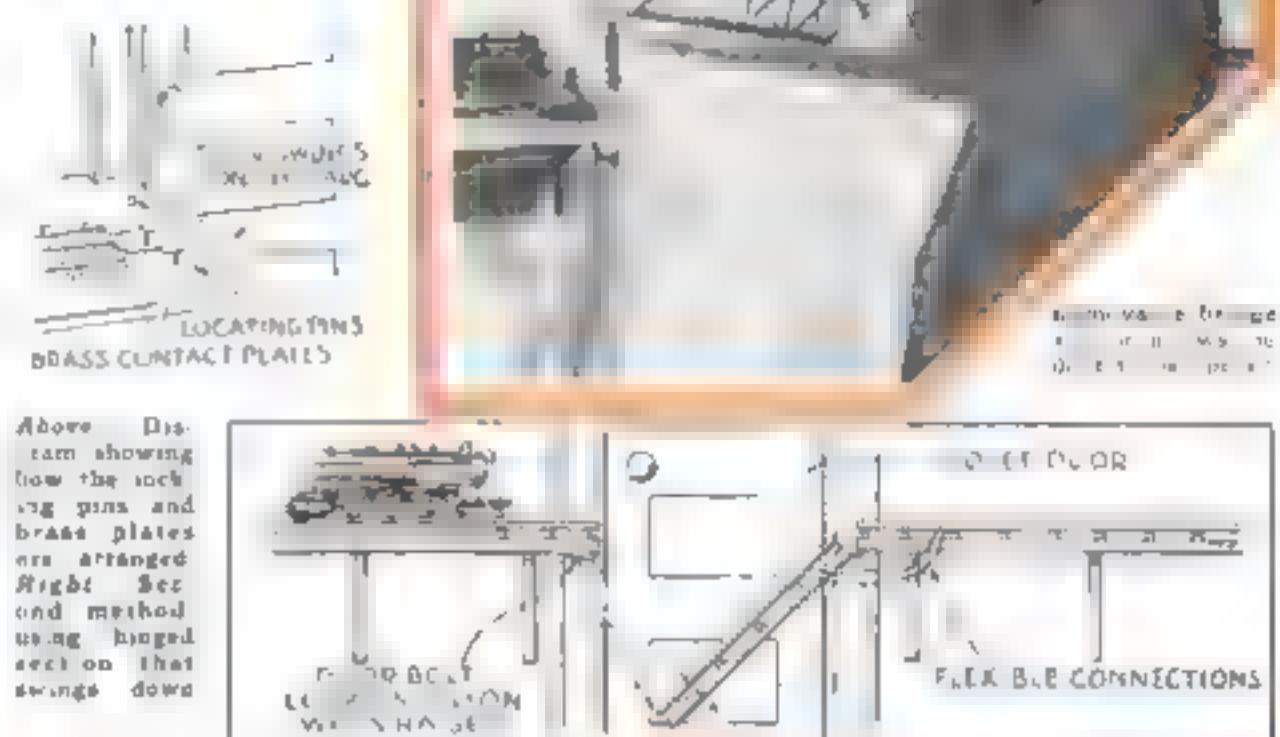
MODEL TRAINS

Pass Doorway on Bridge

Five exceptionally useful kinks for those who operate miniature railways

IT OFTEN happens that the room in which a model railway system is to be located has a door that opens inward. This makes a continuous track circuit an impossibility if the installation is to be mounted permanently on a shelf around the wall, because the door interrupts the circuit. A solution of this problem is shown at the right. The shelving is carried to the door jamb on both sides, and then a trestlework bridge is built to join the open ends when the door is closed. By means of spring contacts and tiny locating pins, the bridge can be lifted out and replaced without disconnecting any wires.

In cases where a bridge of the type shown is not desired, another scheme is to fit a hinged section which can be swung up into place when the door is closed and swung down out of the way when it is necessary to go in or out. Flexible leads can be carried to the track on the hinged section. It is possible to fit the movable piece so that it swings up, but it is much simpler to have it swing downward.



Adding Weight to Cars

TO ADD weight to some of the units of your model railway is often desirable. A locomotive, for example, will pull a much heavier load and run with more realism if it is loaded to give the wheels better traction. Again, you may want to equalize the speed of two different trains. Additional weight applied to the faster train will do the trick. The simplest way to add weight is to bolt flat lead plates underneath the body as shown at the right. This keeps the weight low as well as out of sight. Strips of strap iron will do if lead is not available. Drill through the floor of the body and the extra piece, and fasten with one screw.



Bumper Gives When Hit

A WOODEN bumper for model railway sidings is illustrated in the photograph above. It is easily made of the lumber from an old crate. The size should, of course, be in proportion to the scale of the track.

In cases where the end of the siding is so located that a train running off the end will come to grief by falling off the table, the wood parts of the bumper should be solidly screwed and glued together. If, however, no harm will come to the cars or locomotive if they go off the end of the siding, it is an advantage to put the bumper together with light brads so that it will be strong enough to hold against ordinary jars, but will let go if struck hard by a runaway train and thus not bend the couplings or put dents in the ends of the rolling stock.



Cables for Locomotives

ORDINARY stranded wire is not suitable for the electrical connections between the two motors of a double motor driven model railway locomotive. An exceptionally flexible wire for this purpose is the so-called "litz" wire used for winding high-frequency radio coils. The photograph above shows a connecting cable joining two motors that is made of "litz." The group of four wires is armored with a sheathing of tire tape torn into narrow strips.

A Simply Made Flood Light

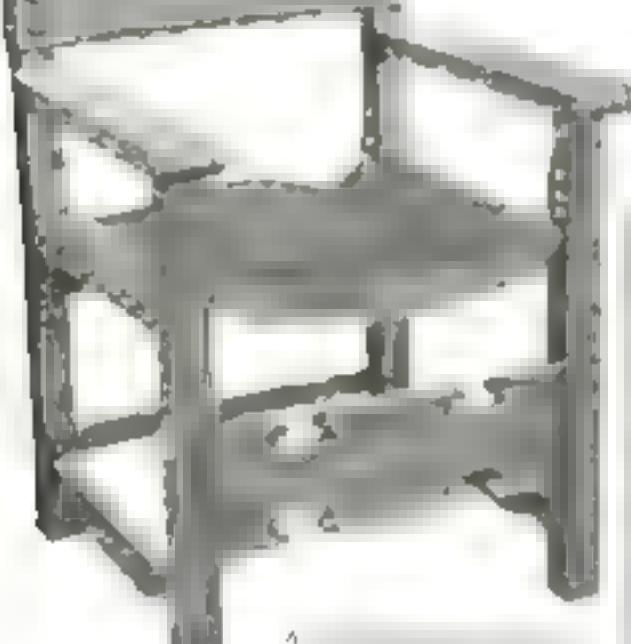
FROM an empty round talcum powder can, an automobile type single-contact socket, and some radio bus wire can be made the little flood light shown at the left. The lower portion of the talcum powder can is cut off and the cap removed so that the socket can be soldered into place. The framework is made from bus wire, and the whole is given a coat of black paint on the outside. This unit is useful to flood light a station or some special scenic effect.

Comfortable . . . Beautiful . . . Easy to Build

An ARM CHAIR

OF MAHOGANY AND COWHIDE

By Hi Sibley



Technical drawings and dimensions are given at the right.

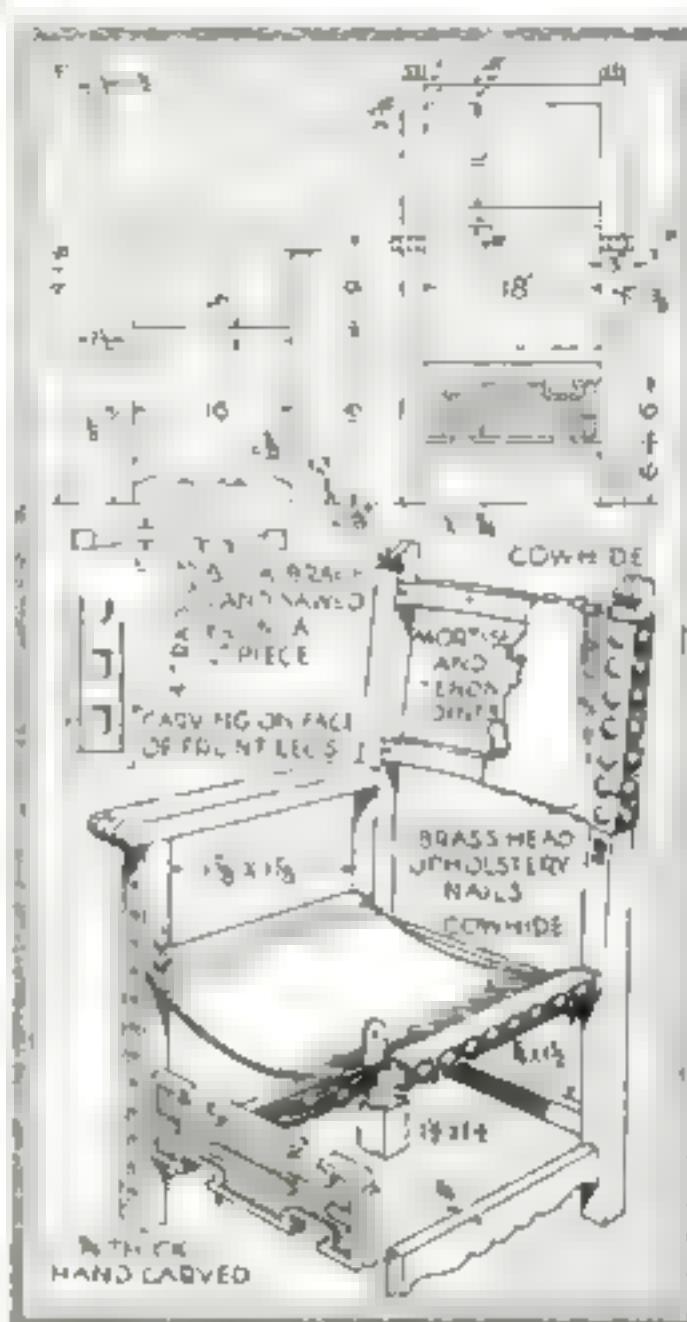
REAL comfort is combined with simplicity of construction in this fine example of an old Spanish armchair. It is a design handed down by the old padres of California who were obliged to do the best they could with the simple tools and materials at hand and who succeeded in creating a distinctive style that has been popular for many generations.

Making the chair will prove a comparatively easy task for the home woodworker, provided he does not mind attempting a little simple woodcarving and has access to a band saw large enough to cut the curved cross members and uprights for the back frame. If necessary, of course, those members can be sawed out at a woodworking mill, or at any well-equipped carpenter's shop.

The chairs shown in the photograph were built by B. D. Harrison's wood-working class at the John Muir Technical School, Pasadena, Calif. They are constructed throughout of Mexican mahogany of the variety known as Tabasco, and the best grade of cowhide was used for the seat and back. The materials cost in California about \$10 for each chair. By using less expensive wood and leather, one could, of course, cut down this outlay.

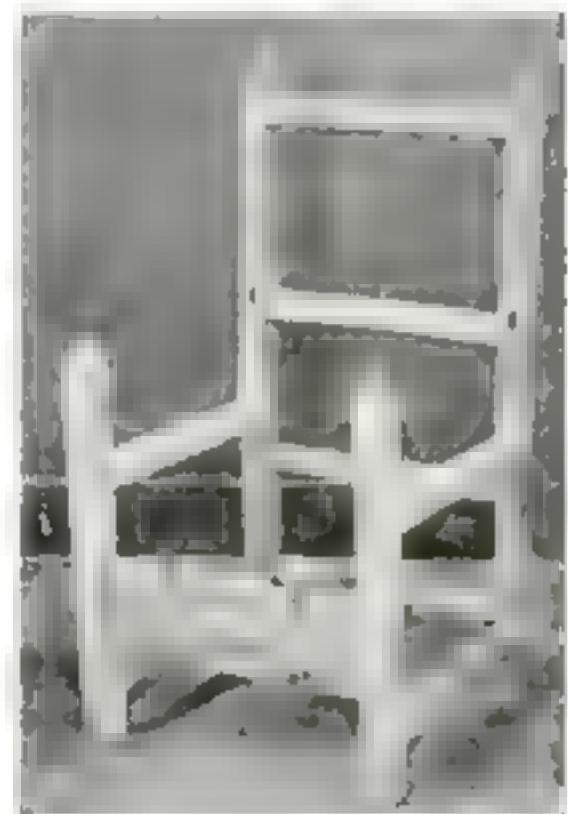
Note that the front legs are straight and $1\frac{1}{2}$ in. square in section. The rear legs have the same section at the bottom, but at a point 18 in. from the floor they start to incline backwards and from this point they also taper to $1\frac{1}{2}$ in. thick although retaining the same width— $1\frac{1}{2}$ in. For cutting out the rear legs with their $2\frac{1}{4}$ -in. backward slant a piece $4\frac{1}{2}$ in. wide will be required. The curved back braces are cut from a 2 in. thick piece on a 4-in. radius, leaving them, when complete, only 1 in. thick.

The leather seat is supported on $1\frac{1}{2}$ in. square pieces. All cross members are joined with well-glued mortise and tenon joints. Take pains to have the joints fit



snugly. A fine chair of this class deserves your best workmanship, and its durability depends largely upon the way the joints are made and glued.

The carving, which should be done as



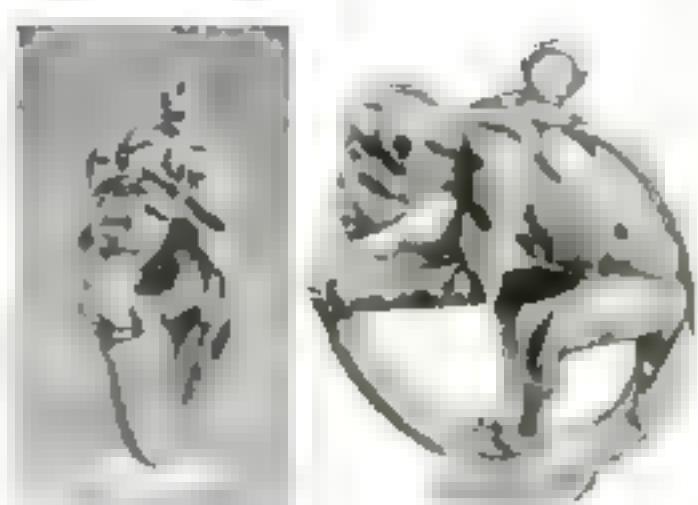
The frame before the arms are added. All joints must be strongly mortised.

indicated in the drawings, will not tax the amateur's skill, as any irregularities merely enhance the rugged handmade look.

Sandpaper all parts, except the carved work, to a velvety smoothness, and if the chair is made of Tabasco or Philippine mahogany, moisten the wood with water to cause the grain to swell, and sandpaper again. Then stain the wood, apply paste wood filler, and finish with three coats of shellac. Sandpaper lightly after the stain and filler coats, but use very fine steel wool to rub down the first two coats of shellac. Steel wool of the No. 3/0 grade is suitable, if it can be obtained. The last coat of shellac is left untouched.

HOW TO WHITTLE A PEACH-PIT MONKEY

WHITTLING peach pits is a favorite schoolboy pastime, but it is rare that so skillful an example is available to copy as that shown at the right. It was made by Edward A. Ringhoff of Denver, Colo., with a pocketknife, and ordinary nail file, and a small piece of steel wire like an old-fashioned knitting needle. It is best to use a peach kernel that has aged about four months. The smooth edge forms the back of the monkey and the blunt stem end the head. It is important to select a pit that has its natural grooves properly spaced at the upper end for the ears. —Ruth D. Watson



A whimsical monkey charm carved from a peach pit.

Paneling Walls with Paint AND OTHER SHIPSHAPE HOME HINTS

INTERIOR walls that are decorated with a flat paint in a solid color can be improved greatly by the addition of striping lines in a darker shade. These are arranged to give the effect of panels. Although many use an ordinary beveled straightedge to guide the striping brush, better results obtain equally good results, with less chance of smearing the stripe, if they guide the brush with the fingers in the manner illustrated. Since in many cases the striping is to follow wood trim and outline doors and windows, the trim itself can often be used in place of the straightedge. Although a single wide stripe is sometimes used in paneling, better effects can be obtained with two parallel stripes, one wide and one narrow. The stripes usually should be placed 3 or 4 in. from the trim and ceiling line, and the widths vary according to the size of the room. The wider the stripes, the farther they should be from the trim.—M. W.



When plain, flat wall paint is used to decorate a room the bareness of the walls is easily overcome by the use of stripes.

How to Stop Small Boiler Leaks

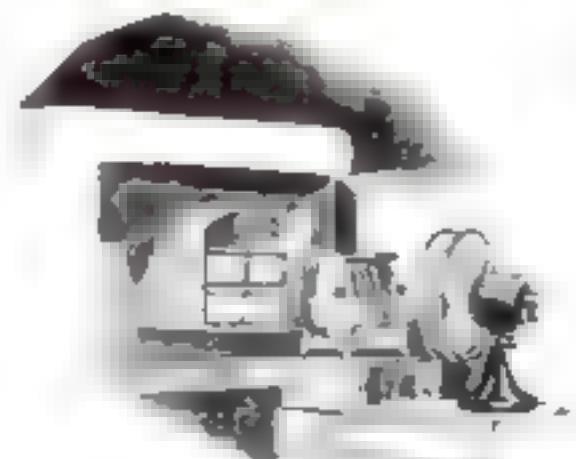
SMALL leaks in a steam boiler should be repaired at once, but this does not necessarily require the service of a plumber. It frequently can be done by adding a mixture of bran and corn meal to the boiler water. To make the repair, the water in the boiler should be warm. First remove the safety valve and, after making sure that the water level is within about 2 in. of the valve opening, pour in a mixture of 1 qt. bran and 1 pt. fine corn meal.

Replace the safety valve and build up the fire. After the water has been boiling for at least forty minutes, allow the fire to die down and carefully remove the safety valve. Next draw a bucket of water from the drain faucet and pour it into the valve opening. When the valve has again been replaced, rebuild the fire to the boiling point. It is best to repeat this cycle of operations at least three times.—K. E.



Quick Way to Defrost Refrigerator Coils

APARTMENT house dwellers having mechanical refrigerators served by a central compressor unit in the basement need not wait for the general monthly defrosting of the entire system to remove the frost from the refrigerating coils in their own cabinet. An electric fan placed back of an electric toaster or a hair drier of the type having heating coils can easily be arranged so as to blow hot air on the coils and melt the frost. This usually takes from ten to fifteen minutes. It is best to remove the more perishable foods during the operation.—WILLIAM C. REICHARD.



Defrosting a refrigerator with fan and electric toaster

Four Important Jobs for November

- Take down all screens.
- Rake and burn leaves.
- Clean outside drains.
- Turn off water supply to outside fixtures that are likely to freeze.

Acid Cleans Water Gage

BEFORE starting up the heating plant for the winter, the home owner will do well to inspect the insulating covering. If the asbestos has become cracked or loosened, it can be repaired with asbestos cement, which is obtainable at most hardware and plumbing supply shops. If the glass water-level gage on the boiler has become so covered with rust that it is impossible to see the water, it

can be cleaned in the following way: Build up at least 3 lb. of steam pressure in the boiler. Close both water gage valves; then open first the bottom petcock and next the top valve. As soon as the steam rushes out through the petcock, close the top valve and immerse the open petcock in a solution made up of one cup of hot water and one teaspoonful muriatic acid. Turn the steam on until it bubbles through the solution, then turn it off, creating a partial vacuum and causing the solution to be sucked up into the tube. Repeat this as often as necessary to clean the glass; then close the petcock, open both valves, and the job is done.—F.Y.



Cleaning water gage with muriatic acid

Damp Resisting Kalsomine

A DAMPROOF or water resisting kalsomine or whitewash can easily be made by adding about $\frac{1}{2}$ lb. of waterproof casein glue to every 16-qt. pail of the finish. Mix the glue powder with equal parts of water by volume and, when it is dissolved, stir the resulting liquid into the kalsomine until thoroughly mixed.—B. D.

• YOU CAN AMAZE YOUR FRIENDS WITH THESE

New Fan Whittling Stunts

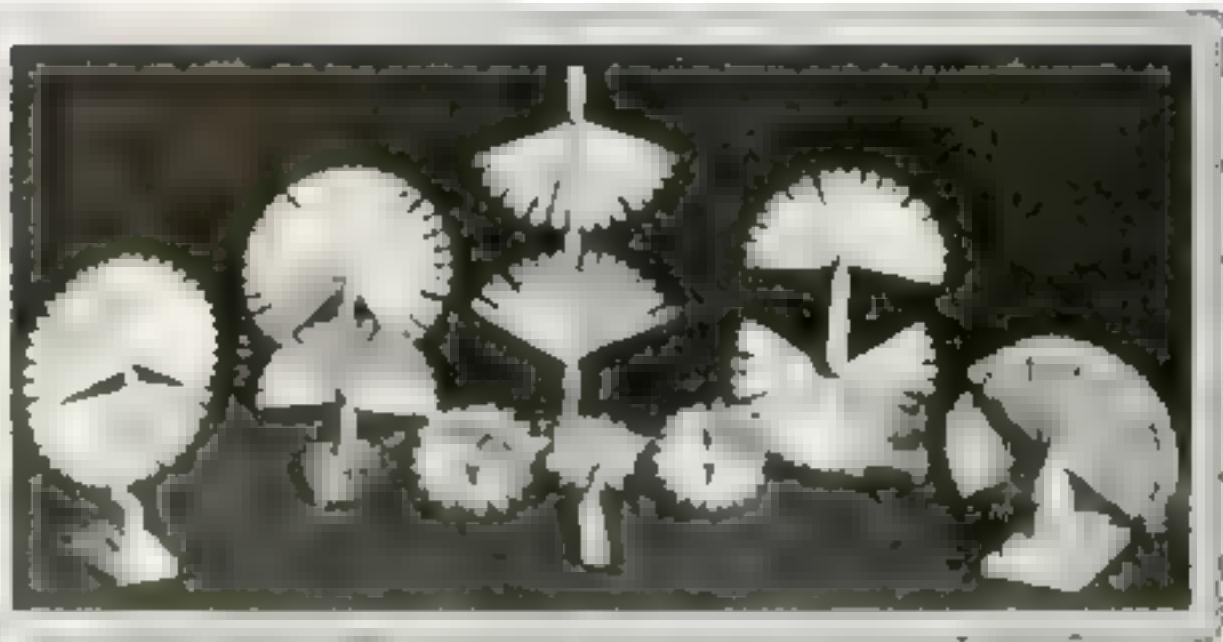


Fig. 1. Three types of fans. The lower one is a figure of a girl with a fan skirt.

By E. J. Tangerman

WHITTLING ornate fans from a single block of wood is a favorite stunt. It looks difficult but is really a comparative simple matter. Few whittlers realize however that the same method can be adapted in ways never before used and that such miraculous looking feats can be accomplished as carving the figure of a woman in a billowing skirt, or making a bird with outspread wings and tail in a cage—all from one piece of wood.

The first requirement for any type of fan is a piece of fairly soft straight-grained wood such as white pine or basswood. Thickness does not particularly matter except that it does, of course, affect the blade width and consequently the width of the entire fan. Any width between $\frac{1}{4}$ and $\frac{3}{4}$ in. will do. In the drawings

A, B, C, and D of Fig. 2 are illustrated the fundamental steps in making a simple fan. A block such as A is notched as at B to provide a thin part upon which the individual blades can be pivoted. The blades are produced later by splitting the piece and spreading the sections apart some sort of end design, such as that on the block at B or the more complicated design at E, should be put on the end of the blades before they are split apart. All sorts of elaborate shapes may be cut and holes may be drilled through to form a tracery or scrollwork.

When the finished blade shape has been produced, the block is soaked in water for from twelve to twenty-four hours. It is then removed and the leaves or blades are split apart as at B, care being taken that no section of the split goes

straight.

As soon as the blades are split and while the block is still very wet, it is grasped by the butt or base and by the tops of the blades so that the blades are held tightly together. The butt is then twisted one quarter turn. This begins the separation of the leaves, as at C, and they can then be spread individually as at D. At their tips the blades may be locked or interlocked as shown, or they may be held separate by passing a doubled cord under and over and knotting it between each blade.

This procedure results in fans of the type shown in Fig. 1. One of them, the triple fan at the bottom of the photograph in the center, consists of ten complete circular fans all made on the one piece four in the middle and three at each side.

The first step in its wider application is to make a (*Continued on page 99*)

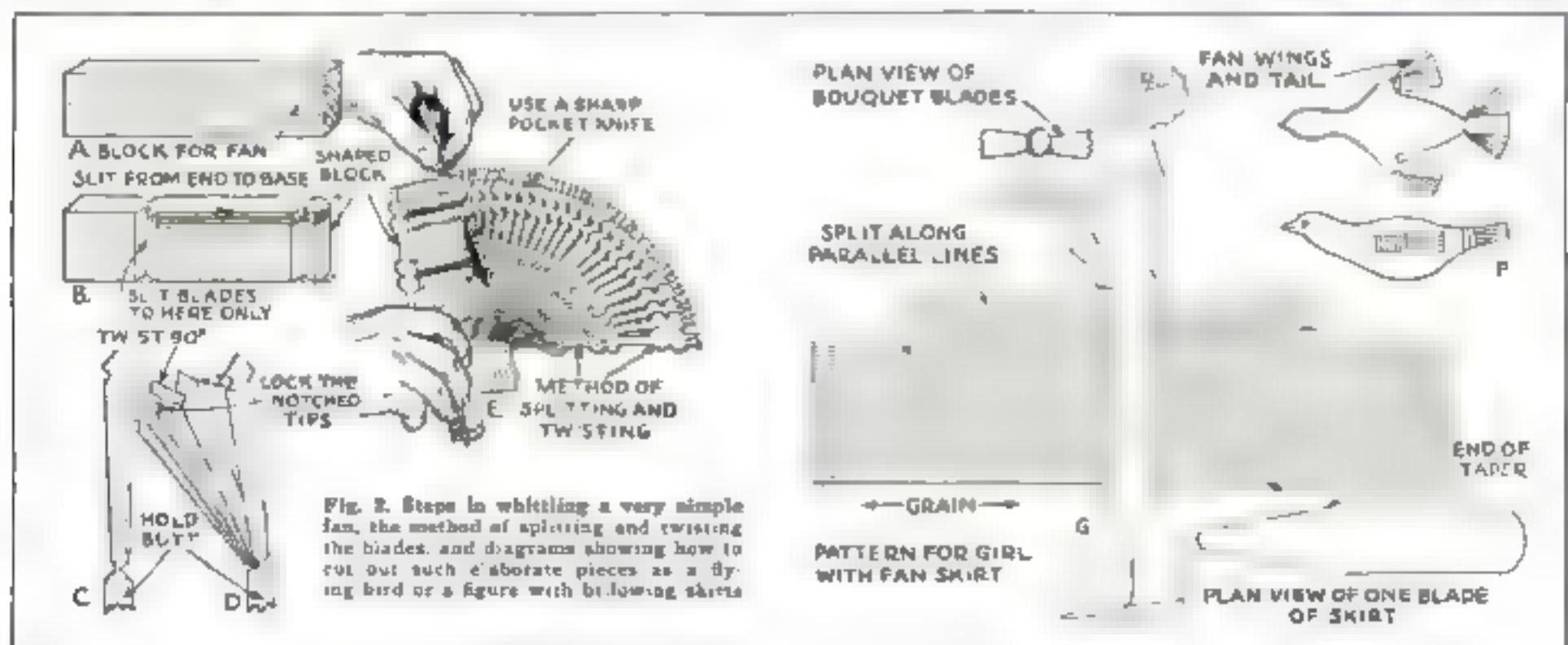


Fig. 2. Steps in whittling a very simple fan, the method of splitting and twisting the blades, and diagrams showing how to cut out such elaborate pieces as a flying bird or a figure with billowing skirt.

Realistic Seaplane Model

REQUIRES ONLY TWENTY-FIVE SIMPLE PARTS

MODEL builders who are tired of constructing ordinary airplanes and would like to try a flying boat design for a change will enjoy making this realistic *Groswind-It-al* seaplane (Capt Wolfgang von Gronau's ship). White pine or balsa wood serves for most of the construction, and only twenty-five parts in all are required—not counting the hull cradle. Every one of these parts is easy to cut out, and the process of assembling them involves no difficulties, even for the beginner.

The model has a wing spread of 24 in., and the hull is 15 in. long. Its scale in relation to the full size seaplane is $\frac{1}{6}$ in. equals 1 ft.

For the hull, plane a pine blank to 2 by $2\frac{1}{8}$ by 15 in. Draw the cutting lines—that is, the top and side views—on the blank with pencil. Then shape it with saw and plane, and finish with sandpaper. Cut out the cockpit with a coping saw and make a slot vertically in the tail end to take the vertical tail. The horizontal tail is attached to the vertical tail by the slot method and braced with two metal struts *P* as shown.

Shape the wing from a pine blank $\frac{3}{8}$ by 3 by 24 in. It is mounted on the hull with the seven wooden struts marked *C*, *D*, and *E*. Only the four struts *C*, however, are set into the wing and hull (see front view), the other three struts run diagonally. The four wing struts *A* and *B* are metal. Their upper ends should be fastened with small brads, and the lower ends set into slots in the floats as shown.

The floats can be shaped from wood blanks $\frac{3}{8}$ by 2 by 3 in. Make one right and one left. Four wire studs 1 in. long will hold them securely in place.

Shape the motor housing from a wood blank 1 by $1\frac{1}{4}$ by $2\frac{3}{8}$ in. Glue it to the top of the wing and glue the radiator to the bottom of wing, just behind the rear struts. Fasten the propellers to the motor housing with brads and place a small wooden washer between each propeller and the housing.

Paint the whole model aluminum and use black to indicate the exhaust ports, motor housing details, radiator lines, and round windows on hull, and also the hinge lines on the tail units. This model will also look well if painted Chinese red and trimmed with aluminum instead of black, as shown in the photographs. Polish the aluminum propellers.

By
Donald W. Clark

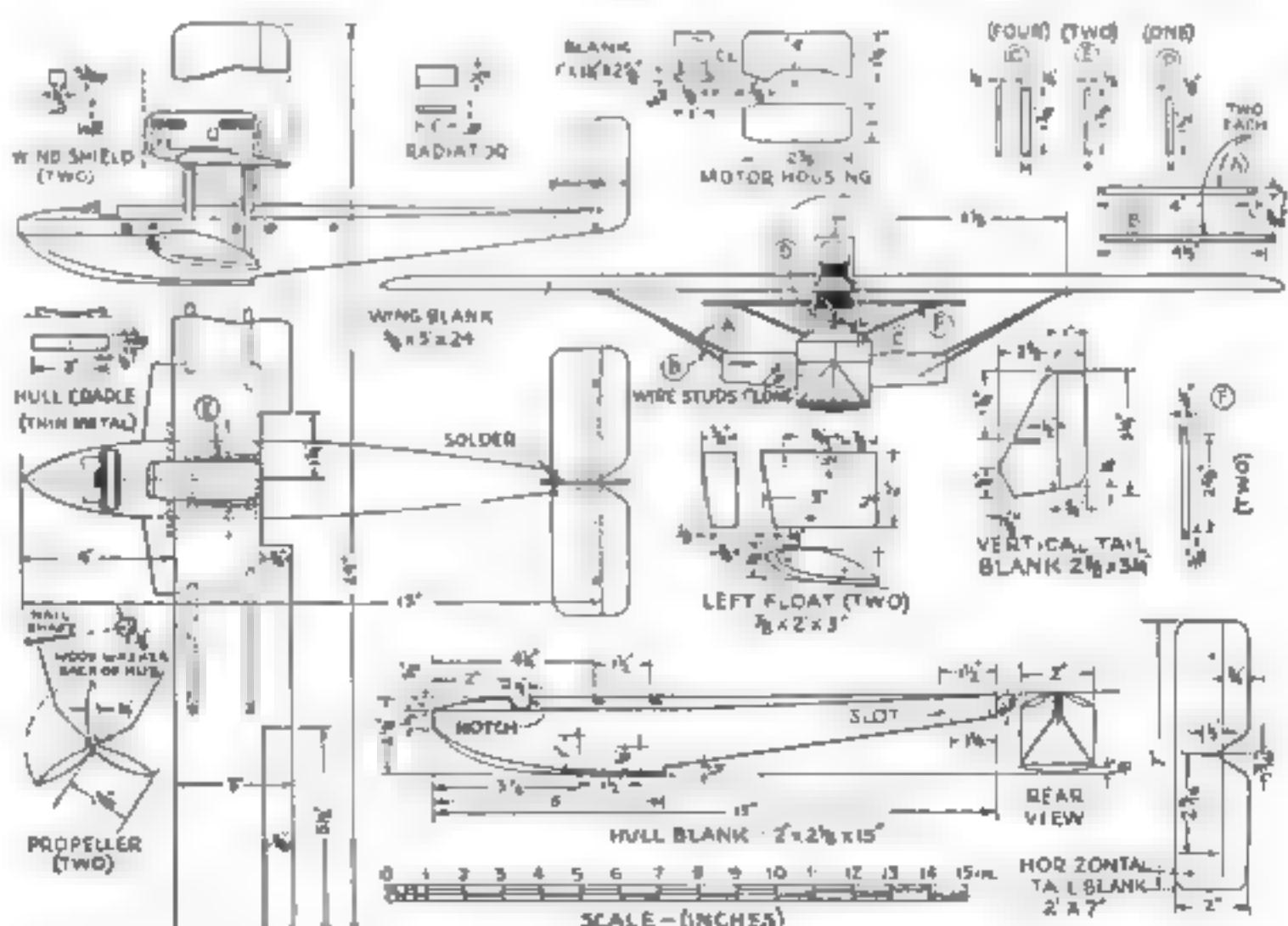
The completed model is shown at right. It is painted Chinese red with aluminum trim.



Planing one of the floats. Note how the motor housing is cut out to fit over the wing



It is important to mark the holes for the wing-mounting struts accurately on the hull



Side, top, and front views of the assembled model, and detail drawings of the hull and all the smaller parts



SQUARE KNOTS

form intricate pattern in this

Woven Belt

By
KENNETH
MURRAY

A notched stick tied around the chest aids in holding the cords taut while a knot is made. A well-knotted belt of exceptional durability.



SQUARE-KNOT work, a pastime of sailors the world over offers to the home craftsman a fascinating type of handiwork. Tiny knots, tied one next to the other, are so arranged as to form woven articles of unique design.

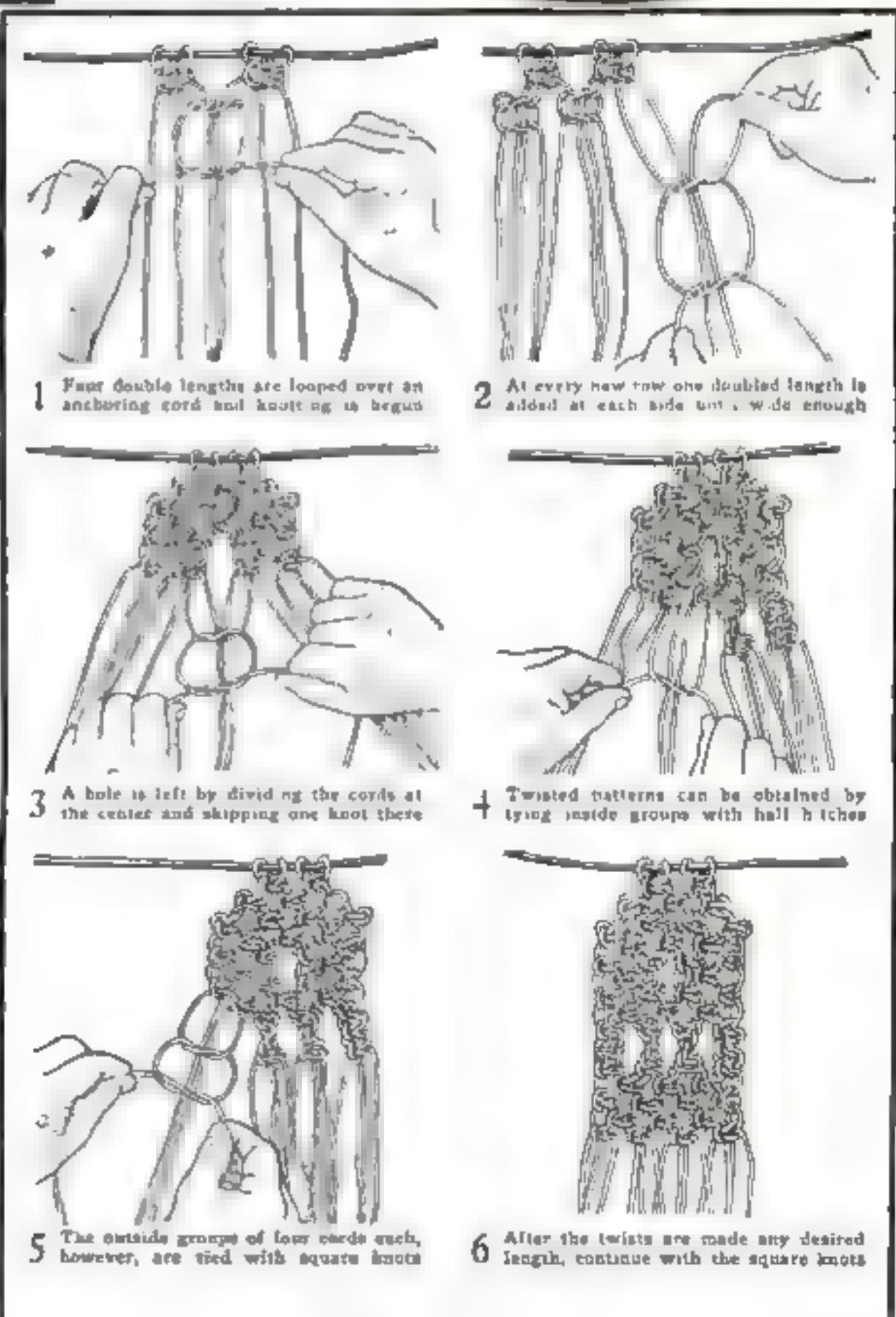
To make the durable and attractive square-knot belt illustrated, some No. 9 three-strand white cotton or linen cord and a nickel or mother-of-pearl buckle are the only materials required.

The cord is cut into double lengths, each being seven times as long as the finished belt. The start is made at the tongue or loose end of the belt by looping four double lengths over an anchoring cord fastened to the back of a chair or other convenient support. Square knots are tied in these as shown in Fig. 1, snur cords being used to form each knot. To hold the two undercords taut while a knot is being made, twist them around a notched stick fastened around your chest with a cord as in the photograph above.

At the beginning, two doubled lengths are added to each new row of knots, one doubled length being introduced from each side as shown in Fig. 2. These cords are added to each new row until the belt reaches the desired width.

Designs are worked into the weave by skipping knots. In Fig. 3 a hole for the tongue of the buckle is being formed by skipping one knot. This is done by dividing the cords into two groups of equal number, knotting each group separately and then knotting the inner cords of the two groups together as illustrated. Attractive twists in the center of the design can be made by dividing the cords into groups of four each as shown in Fig. 4 and knotting the inside groups with half hitches (ordinary knots). These automatically form into a twisted band. The two outside groups of four each are tied with square knots as shown in Fig. 5. Be sure throughout the work, that the knots in each row are tightly drawn before proceeding with the next.

If you would like to see other designs for fancy knot work published, write to the Home Workshop Editor.



Hints on Twist Drill Economy

FOR SMALL SHOP MACHINISTS

Preserving twin lips... How to thin the web near shank... Starting big holes accurately

By

Hector J. Chamberland

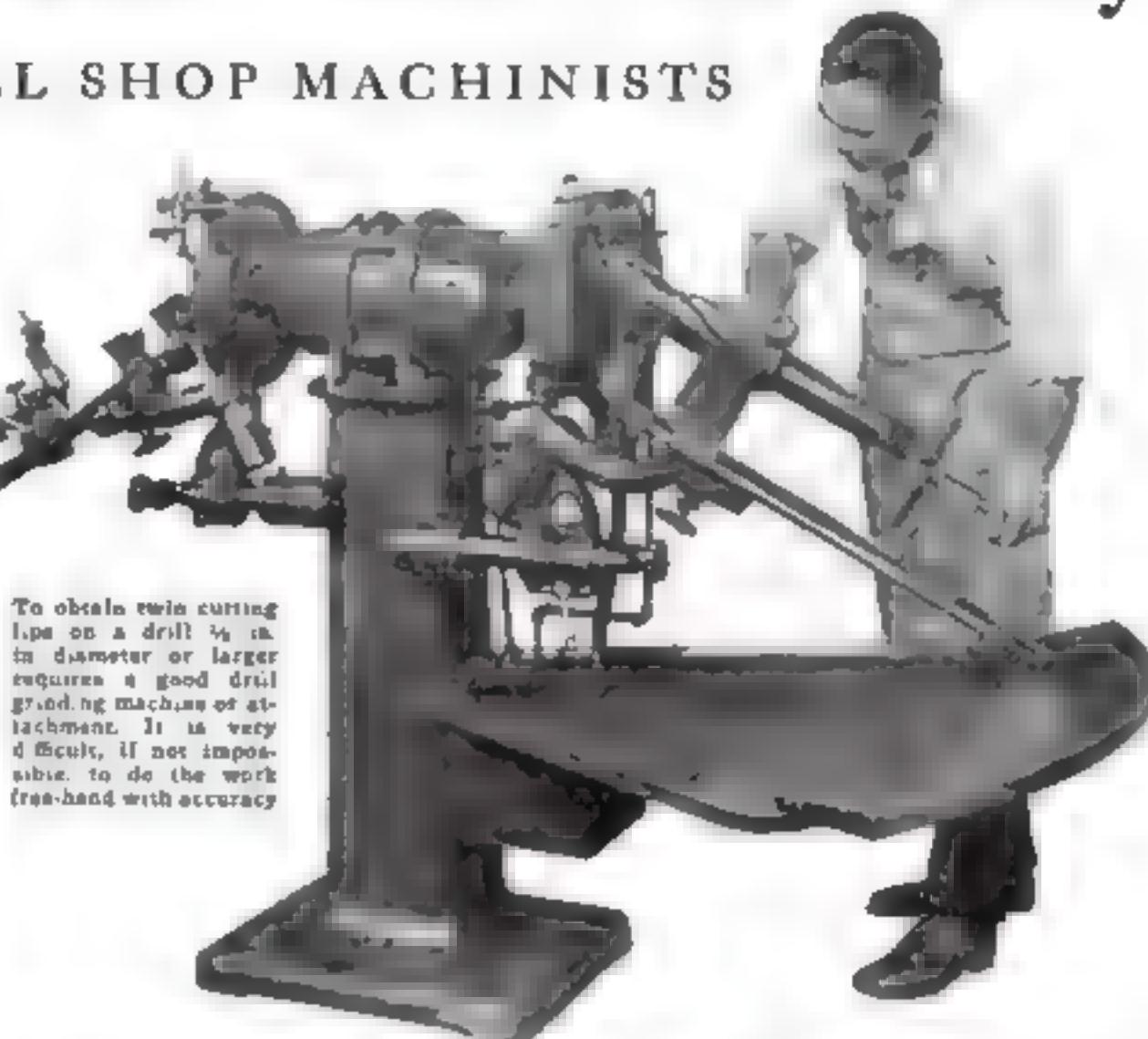
BECAUSE twist drills are among the most frequently used tools, their maintenance has been the subject of more consideration than almost any other machine shop item. Nevertheless, the all-around machinist in the average small shop is not always familiar with the best ways to insure economy in the use of twist drills.

To some mechanics, of course, a drill is only a means for making a hole for an ordinary bolt, but a machinist or toolmaker is compelled to regard a twist drill, to some extent at least, as a precision tool.

Large plants, through their individual systems of tool upkeep, get dollar for dollar on their drill investment, but in the smaller shops and job shops conditions have reached such a stage that these tools are anything but what they are intended to be. The reason for this is quite clear. The remaining mechanics all have access to the crib, and whether it is ignorance, neglect, or something else, one of the force will select the drill he wants, close his eyes to the drill point grinder on his way out and attempt to sharpen it on any old grinding wheel he can find. This particular machinist or toolmaker may boast that he is a first-class man and that practice has made him a perfect drill grinder. On the other hand, the writer has every reason to make the statement that the average mechanic is yet to be found who can produce twin cutting lips on a drill $\frac{1}{2}$ in. or larger by any other means than the use of some such machine as that shown in the photograph above. What nonsense for anyone to regard this equipment as a mere ornament, when drill manufacturers advocate its use as the basic solution for economical and accurate drilling.

It is a well known fact that drill troubles can rarely be blamed on the manufacturers. Drills have twin lips when they leave the factory. Medium and large drills are made either by milling flutes in round stock or by forging and twisting flat stock. The latter drill may be regarded as superior, as it evidently has more strength to resist twisting, still, the milled high-speed twist drill is good enough for any shop if it is given due care.

A successful drilling operation is a three-sided affair. First comes the drill point; second, speed and



feed; third, rigidity of work and machine. Every apprentice boy knows the requirements of a drill point and is made to understand that unless the cutting lips are of equal lengths and equal angles and the clearance behind the lips is correct, no drill is of much value. There is also something else to remember—the included angle and clearance varies with the material to be drilled, which makes free-hand grinding a still more serious matter.

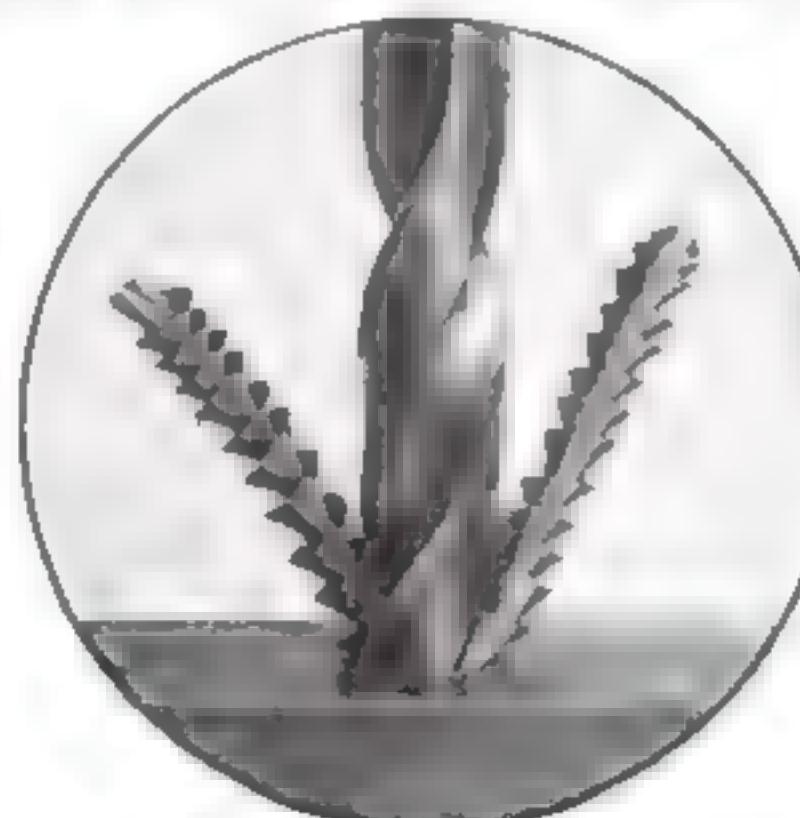
A copy of the chart given at A in the drawings, if pasted inside the cover of the tool box, will save some inconvenience at times. It is not the intention of the writer, however, to go into details as to grinding

a drill point correctly. If the drill to be used is over $\frac{1}{2}$ in., use the ordinary, common sense method and you will have no trouble. If the shop is so small that no drill grinder is available, at least use a sage and practise on old drills before you attempt to sharpen new ones. Any operator can get information on sharpening merely by writing to any large twist drill manufacturer.

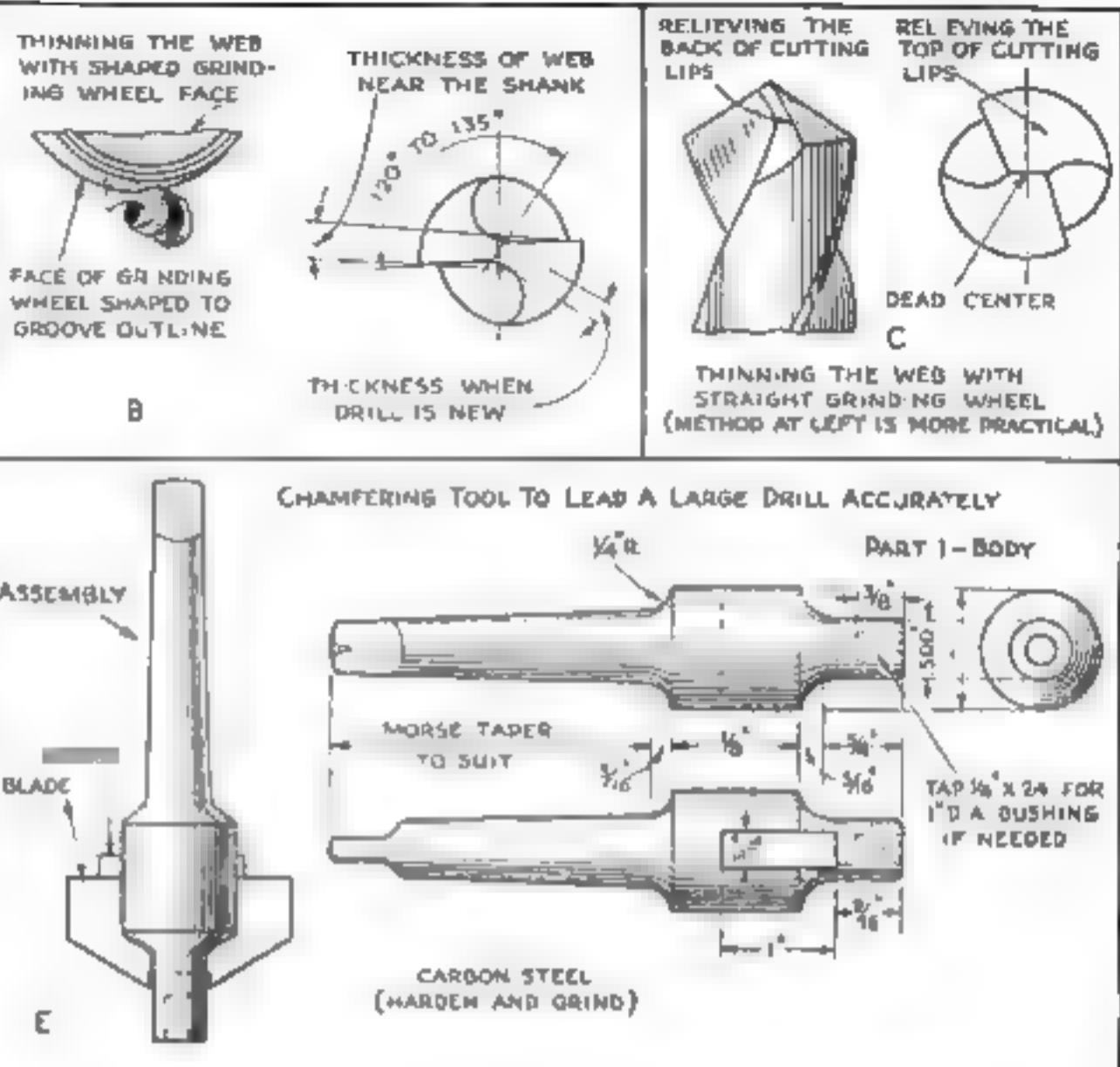
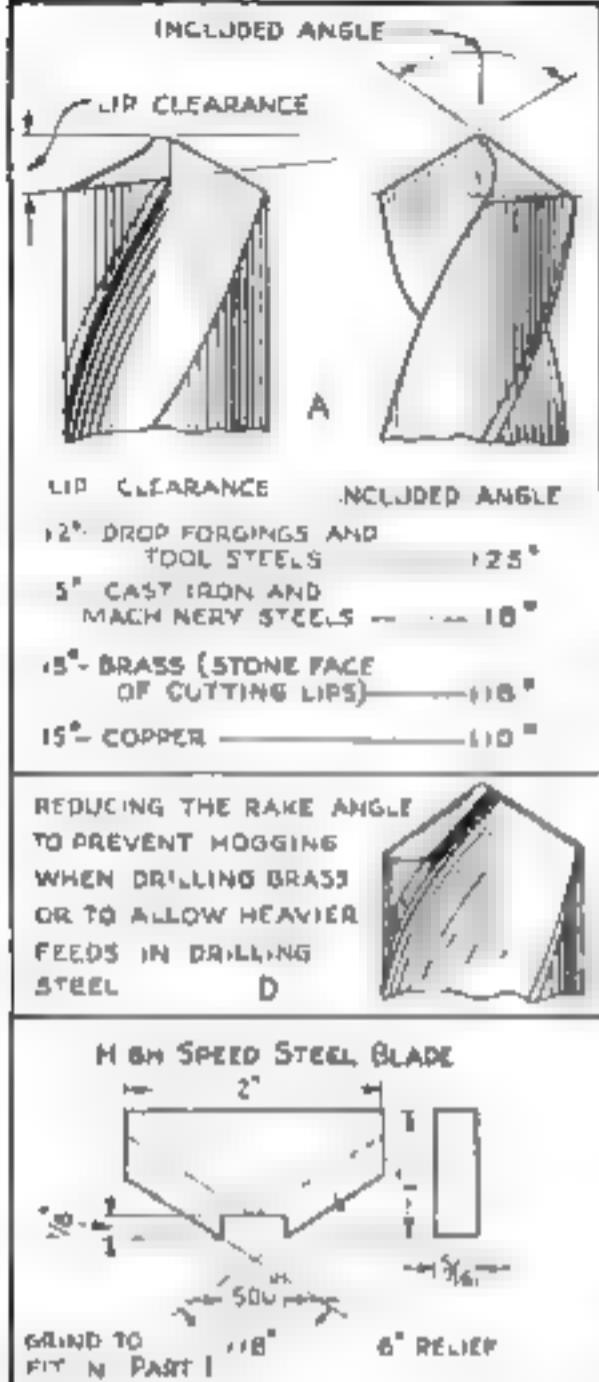
Next in importance to sharpening are the feeds and speeds. In this case the operator should use his head and, still better, refer to his machine shop handbook. It is better to favor speed than feed regardless of how perfect the drill point may be. Unnecessary speed will send a costly drill to the junk pile as fast as one that has some defect caused by a bad grinding operation.

Generally speaking, the word "speed" in drilling means peripheral speed; in other words, the distance the drill would travel if it were rolled on its side and not the number of revolutions per minute (unless so stated). As for feed, it is well to bear in mind that a drill is not a corkscrew or a tap and will not pull itself in, therefore pressure is required to advance it. Such pressure is measured by fractions of an inch to a revolution. Evidently, the feed must be governed by the speed of the drill, its size, and the material being machined.

The third essential for accurate drilling is rigidity. Do not attempt heavy work on a light drill press. Any springing action in either the work or spindle is likely to break



When chips like these circle smoothly out of the drill grooves, you need not worry about the efficiency of your drilling equipment.



A chart to aid in sharpening twist drills (A), the use of shaped and straight wheels for grinding flutes (B and C), a drill point for soft metals (D), and a chamfering tool (E).

the drill in two the instant the point pierces the bottom of the hole. If the work is not clamped to the table, the same trouble is likely to occur. The operator who does work with his hand while drilling is not only cheating the company but is likely to pay a visit to the nurse.

If the chisel point of a substantial drill is too thick, it will cut hard. As the drill gets shorter, the web gets thicker; for good results, the thickness of the chisel point should be kept the same as when the drill was new. Web thinning has to be done by hand and it is no boy's job. If this operation is required, do it before grinding the point. There are two ways to do this. If you shape a grinding wheel to fit the flutes, you will get results as shown at B. If the operation is performed on a straight wheel, the point will appear as indicated at C.

When preparing to thin the web of a good drill, make a test on a discarded drill of the same size. The work must be done carefully or the drill will behave worse than before.

If a drill is correctly ground and still cuts hard, use turpentine for a lubricant and note the improvement.

Do not confuse the point of a drill with the dead center. The point is the entire cone-shaped surface at the cutting end, the dead center is the sharp point at the extreme thin end. The rake is the angle of the flutes. So that the drill will not bog in when cutting brass or soft metals, it is necessary to reduce the helix angle as shown at D.

If your drills are machine ground, you

will get results as in the photograph at the bottom of page 78, which shows chips from a properly sharpened drill. If you take chances in grinding a drill, you will never know what to expect.

Drills usually are followed by reamers in accurate work, but sometimes it is required that a drill hole must be kept within close limits. One must realize that if a 1½-in. drill follows a much smaller one that acts as a lead, the two-point bearing of a two-flip drill against a square edge is not favorable to accurate results. If the work is being done in the lathe, a bearing $\frac{1}{4}$ in wide and the same angle as the drill point should be cut on the edge of the

lead hole. This will give ample support for the larger drill.

For use in an upright or radial drill, a chamfering tool made as shown at E will fill the bill. The $\frac{1}{8}$ -in. pilot will accommodate drills up to 1 in., and fitting a 1-in. bushing will give the tool a range up to 2 in. The idea will also prove economical with three- and four-flip drills and even for a reamer. If wear is apparent in the spindle of the machine, the scheme affords some compensation; and in any case, the better the start for the drill, the better the results.

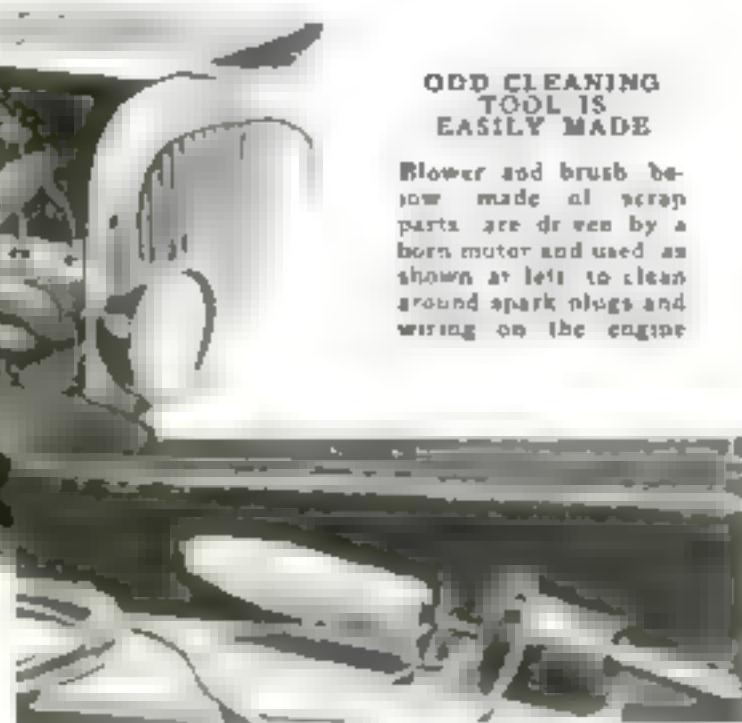
A new drill ordinarily is within .0005 in. of the marked size and will not cut more than from .001 to .002 in. too large if the above suggestions are followed. One must, of course, remember that drills are iron .003 or .004 in smaller in diameter near the shank than at the point, and this must be taken into consideration. Otherwise, when operating a sturdy radial drilling machine, anyone may conclude that if the holes are coming oversize the drill is to blame.

As closing suggestions on the care of large drills, keep the shank free from burrs, and when drifting a drill out of the socket, use a lead hammer and the regular drift key. Also, lay a board on the table to save the drill point.

A second article, scheduled for a later issue, will discuss in detail the care of drill chucks and tell how to regrind the jaws. It will also give hints on the use of small drills and a design for a simple cross drilling jig for round stock.

SHORT CUTS for Auto Jobs

*Homemade Brush and Blower Clean Motor Quickly...
Sliding Windows Can Be Put in Open Car Curtains*



ODD CLEANING TOOL IS EASILY MADE

Blower and brush below made of scrap parts are driven by a horn motor and used as shown at left to clean around spark plugs and wiring on the engine.

MADE from scrap parts the motor-driven brush, with blower, shown above is an inexpensive timesaver for cleaning an automobile engine. The blades from a discarded electric fan of the midget type are mounted on the wire shank of a spoke brush from which the wooden handle has been removed. By means of a loop, a right-angle bend, and some solder, the end of the wire shank is then attached to the threaded end of the armature of a motor from an old horn. The handle taken from the spoke brush forms a convenient grip when attached to the rear of the horn motor housing. It is connected to the car battery by means of a suitable length of lamp cord.

Windows for Open Car

RIGID sliding glass windows can be easily installed in the side curtains of an open car. The wood frame, shown in Fig. 1 consists of four pieces, each having two 3/16-in. grooves to receive the two glass panels. The top and bottom pieces and one end of the frame should be fastened in place first, the stationary and movable windows slid in, and then the remaining side attached. The front glass can be held in place with cement.

Drive Shaft Tube

WHEN assembling the rear end of a car after repairs have been made, it is usually quite difficult to lift the drive shaft tube and at the same time guide the end of the shaft into place. However, if a long plank is placed over

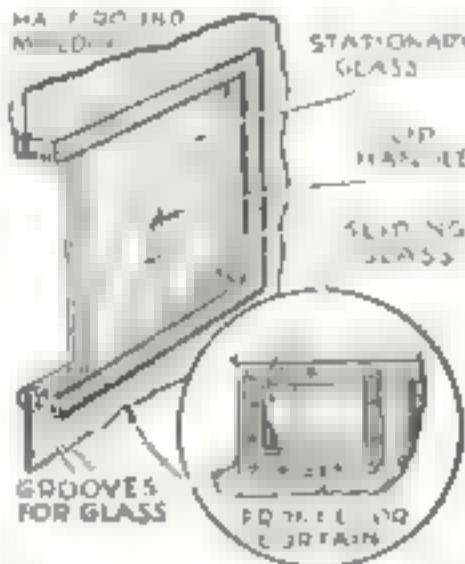


Fig. 1. Wooden frame set in curtains of open car can be fitted with glass windows that will open by sliding



Fig. 2. A long plank is placed over the rear axle and beneath the drive shaft tube to raise tube so the drive shaft can be guided home

ODD CLEANING TOOL IS EASILY MADE

Blower and brush below made of scrap parts are driven by a horn motor and used as shown at left to clean around spark plugs and wiring on the engine.

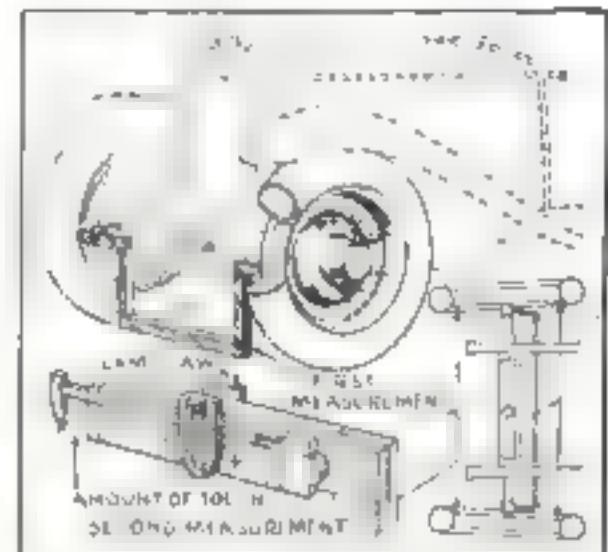


Fig. 3. By clamping a slide caliper to end of a U-shaped wooden frame you have a gage that can be used to test the toe-in of front wheels.

accurate measure of the toe-in. The proper value for your particular car can be obtained from the general instruction booklet issued by the manufacturer.

Twin Guide Mirrors

TWIN mirrors fastened to the rear wall of a one-car garage will aid the driver when he backs the car through the narrow doorway. The mirrors, placed about ten inches from the side walls as

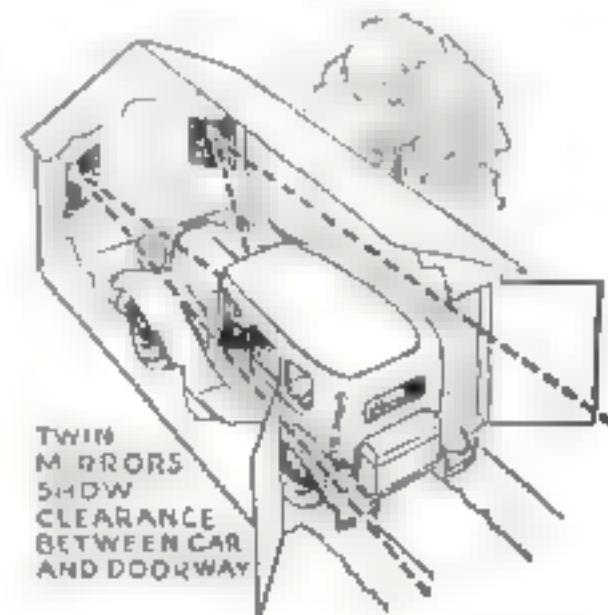
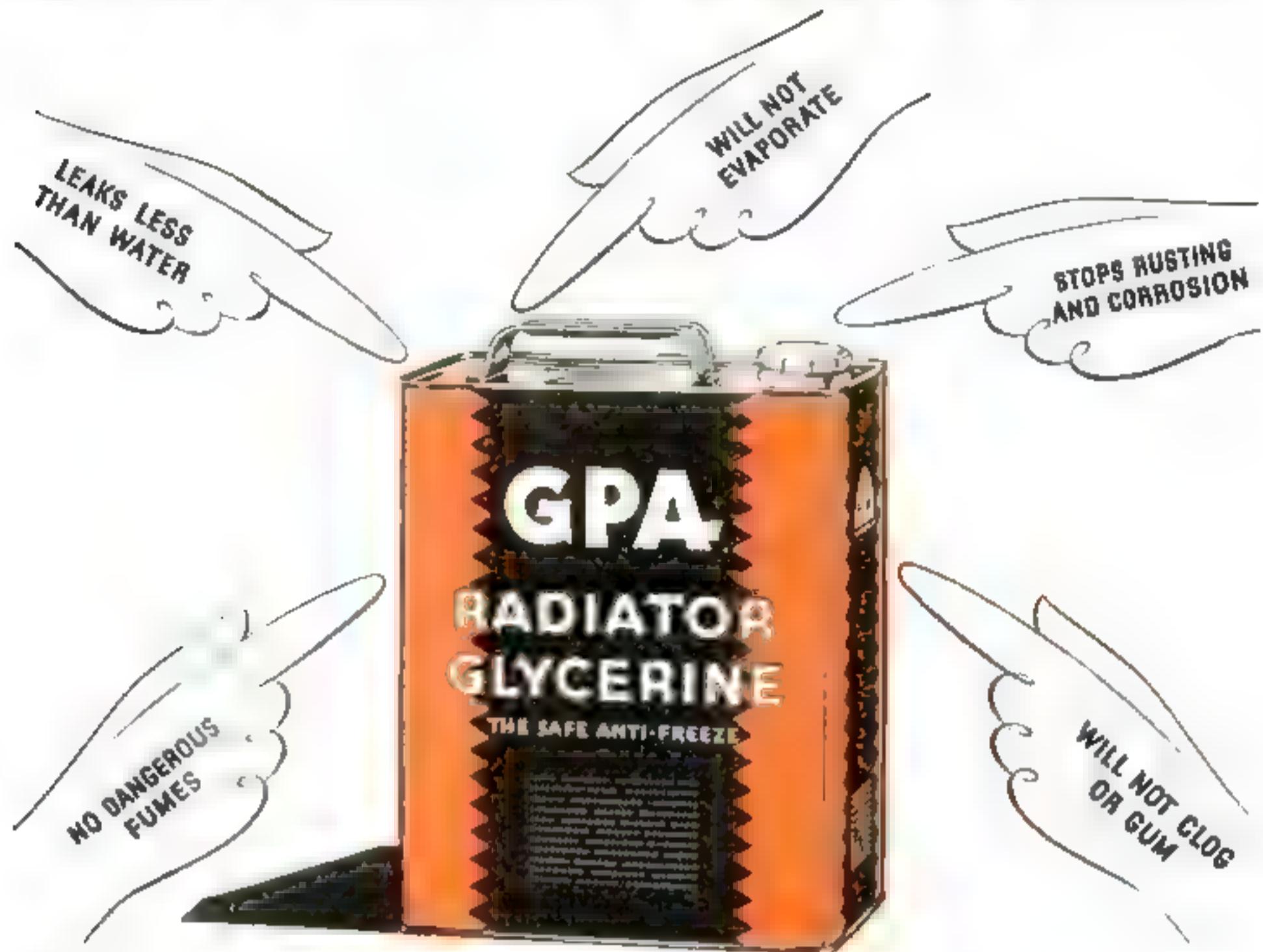


Fig. 4. Two mirrors, placed near the side walls of a small garage, guide driver in backing out.

in Fig. 4, should be adjusted so the driver can see the back fenders on each side. By looking first at one mirror and then at the other, it is a simple matter to keep the car centered in the doorway. The mirrors should be large enough to give a good view of the fenders and each side of the car. Suitable mirrors can be purchased in most five-and-ten-cent stores. Adjust each mirror by having someone hold it at various angles while you check the view from the driver's seat.

NEW! SAFER! COSTS LESS!



THE new G. P. A. is the anti-freeze bargain of 1932!

Not only is G. P. A. considerably lower in price but it is definitely better than ever for your car.

G. P. A. is, of course, permanent as always. It will not evaporate or boil away. One filling lasts all winter. No bothersome refillings!

Not only that, but the new G. P. A. leaks less than water. If your cooling system is water-tight, G. P. A. will "stay put" indefinitely.

Another remarkable feature of the new G. P. A.: It stops the rusting and corrosion caused by ordinary tap water; and this protection continues after G. P. A. is drained out.

It also retards the disintegration of rubber hose. In every way it is better for your cooling system than plain water.

All in all, there are 14 important advantages of the new G. P. A. Read them carefully. See if G. P. A. is not the kind of anti-freeze you want this year.

Safer! Sure! Lower in price!

14 ADVANTAGES OF G. P. A.

1. Gives complete protection against freeze-ups to 30° below zero.
2. Will not evaporate—not even on the warmest days. One filling lasts all winter.
3. Leaks less than water.
4. Protects all metals of the cooling system against corrosion and the rust caused

by tap water. This protection continues after G. P. A. is drained out.

5. Retards disintegration of rubber hose.
6. Positively will not clog or gum radiator.
7. Mixes quickly and permanently with water.
8. Never overheats motor.
9. Does not injure Dues or other finishes.
10. No unpleasant or dangerous fumes.
11. Safe—non-poisonous, non-inflammable.
12. Permits better operating temperatures.
13. Made to G. P. A. quality-standards.
14. Lower in price. More economical than ever.

• **PILL EARLY:** Since G. P. A. will not evaporate you can safely put it in early. Thus you avoid the last minute rush and all danger of early-season freeze-ups.

THE *New* **G.P.A.**
RADIATOR GLYCERINE

GLYCERINE PRODUCERS' ASSOCIATION, 45 EAST 17TH STREET, NEW YORK, N. Y.

Improved Flashlight Methods Make it Easy to . . .

Take Your BEST PHOTOS Indoors

And perhaps you can win one of our new, greatly increased picture prizes

"PUTTING 'em in a plaster cast, or maybe freezing them solid is the only way, I guess," my seat mate on the bus excursion sighed as he shuffled a dozen photoprints. "I see you take pictures, too," he added glancing again at the camera case between my feet. "How do you make children and animals stay still while you take their pictures? I can't. They move every time and this is what I get."

"Why don't you try 'freezing' them with a flashlight?" I suggested, as I examined the funny prints.

"And scare them silly doing it," he scoffed. "Not to mention the dressing-down the wife would hand me if I started filling the house with smoke and dust. Besides, all the flashlight pictures I've seen don't look natural. Everybody shuts their eyes when it goes off, or if you tell them to keep their eyes open, then you get that staring effect."

This man, and many more like him, are way back in the dark ages of flashlight photography, when a flashlight picture was a serious, uncertain, and sometimes dangerous undertaking. Now, with the modern, properly compounded flash powder, flash sheets, flash cartridges, and especially with the new photoflash bulbs (Fig. 1), indoor photography by flashlight is so simple

By
FREDERICK D.
RYDER, JR.



Fig. 1. All set for a photoflash. The camera is pressed against the chest and the thumb is used to operate the shutter. The other hand touches off the photoflash lamp.

anyone can do it. Furthermore, flashlight photography, either by day or night, has certain advantages over shooting pictures by natural daylight or any other form of artificial light.

In the first place, the use of man-made light eliminates the need for guessing the

exposure. A few test pictures will give you accurate knowledge of the strength of any source of artificial light. That settles the exposure question for good or until you change lights or the kind of film or plates you use. This is true with incandescent bulbs, photoflash bulbs, and even with flash powder, if the quantity used is accurately measured.

Secondly, you can arrange artificial lighting to give you just the effect you want—a difficult and often impossible job with daylight. With either the photoflood variety of incandescent bulb or the photoflash bulb, you can direct the light straight down, straight up, or at any desired angle.

The big advantage of the flashlight is its speed. While it is both possible and practical to take snapshots indoors by the aid of high-power incandescent lights, it takes several thousand watts of them, and you have to use fast and therefore expensive lenses and high-speed film. The

\$100 in CASH AWARDS for Indoor Photographs

Here is a remarkable opportunity for you to make your cameras yield a cash dividend and, at the same time, learn by practical experience how easy it now is to take good indoor photographs.

The introduction of photoflash bulbs has overcome all the old drawbacks of taking photographs in the house; in fact, you can be sure that every exposure you make will be successful. There is no noise, dust, smoke or fire risk. Furthermore, the flash is so quick that it will not frighten the most timid child.

It is primarily to encourage you to learn to use this new modern method of taking indoor photographs that POPULAR SCIENCE MONTHLY offers six cash awards for the most photograph-

ically perfect pictures taken indoors by an amateur during the months of October and November, 1932. The photographs may be of any size, type, or subject and, of course, daylight or any kind of illumination or flashlight may be used. The prizes are as follows:

FIRST AWARD	550
SECOND AWARD	25
THIRD AWARD	10
FOURTH, FIFTH and SIXTH AWARDS, \$5 each	15
TOTAL	\$100

Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photograph Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than December 1, 1932, and mark your entry "November Photo Contest." Also write on the back of the negative what illumination was used—daylight, artificial or flashlight and if flashlight which type. You may enter several pictures if you wish, but no entries will be returned. This contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families. In case of ties each tying contestant will be awarded the prize listed for.

Bill learns how to take INDOOR PICTURES

BOB THESE PICTURE
GRANDPA AND BILL LEARN
TO TAKE SNAPSHOTS



All of these photographs taken with G.E. MAZDA Photoflash lamps.

Here's the secret of PRIZE-WINNING INDOOR PICTURES

To take Action scenes with "still" cameras, inside the house or outdoors at night, use G.E. MAZDA Photoflash lamps. They operate simply, from house current or flashlight batteries. A quick brilliant flash and the picture is yours. No noise, smoke, or muss. A new picture calls for a new lamp. Indispensable for shots of babies and children.

To make time exposures . . . portraits . . . interiors . . . indoors or at night, use G.E. MAZDA Photoflood lamps. They operate on ordinary house current and give good pictures with 1 to 5 second exposures. During the two-hour life

of these lamps, many pictures can be made. The new G.E. MAZDA Photoflood lamp is the best lamp ever developed for taking home movies.

* * *

Ask your druggist or photo-supply dealer about their two new aids to indoor picture taking. Better still, get some and try them. That will convince you. General Electric Company, Nela Park, Cleveland, Ohio.

GENERAL ELECTRIC CO., Nela Park, Cleveland, Ohio

P. R. M. 1444

FREE Please send me, free, the folder

"How to make GOOD pictures indoors."

Name _____ Address _____

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GENERAL ELECTRIC
MAZDA **PHOTOFLOOD** **PHOTOFLASH** **LAMPS**

flashlight allows the same result with an ordinary camera and the film you regularly use.

The photoflash bulb, because it makes no noise, no smoke, and cannot cause fire, is ideal for home photography. The duration of the light from a photoflash bulb is about a fiftieth of a second. This is roughly equivalent to the speed of normal flash powder fired from a suitable type of flash gun. An exposure of this length is too long to stop fast motion, but it is ample to "freeze" the normal wriggles of a small child or animal pet into a sharp picture.

One peculiarity of the photoflash bulb is of great value—the virtual absence of the glare that causes subjects to blink or



Fig. 3. Three photoflash bulbs can be set off at once by placing the extra ones in contact with the central bulb.

squint in anticipation. Experienced photographers, trying photoflash bulbs for the first time, can hardly believe that the sudden, lightning-like flicker of light is strong enough for picture taking.

In order to show the differences between photography with electric lights and with flashlight, I took the two pictures shown in Figs. 3 and 4. The second is the best of three attempts to take a picture of a child and kitten with the aid of a 500-watt bulb and an ordinary camera. Many a disgusted amateur photographer has thrown pictures like this into the wastebasket. If the kitten had held still for a fraction of a second longer and the little girl could have been induced to stop squinting because of the bright light, this might have been a good one. In the other two tries, the child appeared to be holding a fuzzy black shadow.

Now look at Fig. 3. Here are the same subjects photographed with the same camera under exactly the same conditions ex-



cept that a photoflash lamp was used instead of a 500-watt bulb. See how quiet the little black imp of a kitten appears in this view. Of course he wasn't really quiet, but the photoflash lamp stopped him. Note, also, the soulful, wide-eyed expression the child chose to assume in this "shot." Yet there is nothing squinty or strained about it because the normal lighting of the room, which was kept going, al-

lowed a natural and easy pose. It is extremely difficult, if not impossible, to get such an unstrained expression in the bright sunlight that permits snapshots with the ordinary camera.

Cats are proverbially quick, yet you will note the wide open eyes of the kitten in Fig. 3. I watched its eyes while this picture was being taken and sure enough, they blinked, but not till a split second after the flash.

Keep this matter of winking in mind when you take flashlights. Watch your subject's eyes and time the flash to come between the normal blinks.

Figure 2 shows another difficult picture-taking problem easily solved with a photoflash bulb. It was held almost vertically above the surface of the water in the aquarium and high enough to be out of the field of view of the camera lens. Except for the slight degrading of detail caused by the molded glass side walls, the flashlight brought out every tiny object.

Fig. 3 (left). Taken with a photoflash lamp. Note naturalness and sharp detail

Fig. 4 (below). What happened with artificial light. The pose could not be had



No apparatus beyond what you already have in the house is required to use photoflash bulbs. They can be screwed into any droplight socket and set off by turning on the current. Be sure the current is turned off before you screw the bulb in place.

It is, however, worth while to use a special reflector fitted with a handle containing an ordinary two-cell flashlight battery. The aluminum surfaced reflector sends all the light where you want it, and the battery eliminates the need for a drop cord to the wall socket.

In case you depend on the house lamp, a homemade reflector that has been given a couple of coats of aluminum paint or covered with aluminum foil will give you good results.

Figure 5 shows what to do when the conditions demand more light than can be obtained from one photoflash bulb. The special folding reflector shown is fitted with clips to hold one or two extra bulbs with their big ends touching the glass of the bulb that is to be fired by the battery. Just why extra bulbs should go off when the center one is fired is not known but the fact remains that they do. If you have no especially equipped reflector the extra bulbs can be tied with string beside the bulb in the ordinary reflector. Be sure the glass surfaces actually touch.

Always test the lighting before you attempt to take a flashlight, whether you use a photoflash lamp or any other flashlight. This is easy to do. First place any available electric light bulb in a socket on the end of a drop cord. Turn on the current to the test bulb and turn off all the rest of the lights in the room. Now hold the test light in various positions and note which lights the subject most attractively.

The reason why the rest of the lights in the room should be turned off is because they will have no effect on the picture taking and therefore should not be allowed to influence the test.

Ordinarily, the best position will be above the camera and on a line making an angle of approximately forty-five degrees with a line drawn from the lens to the center of the subject.

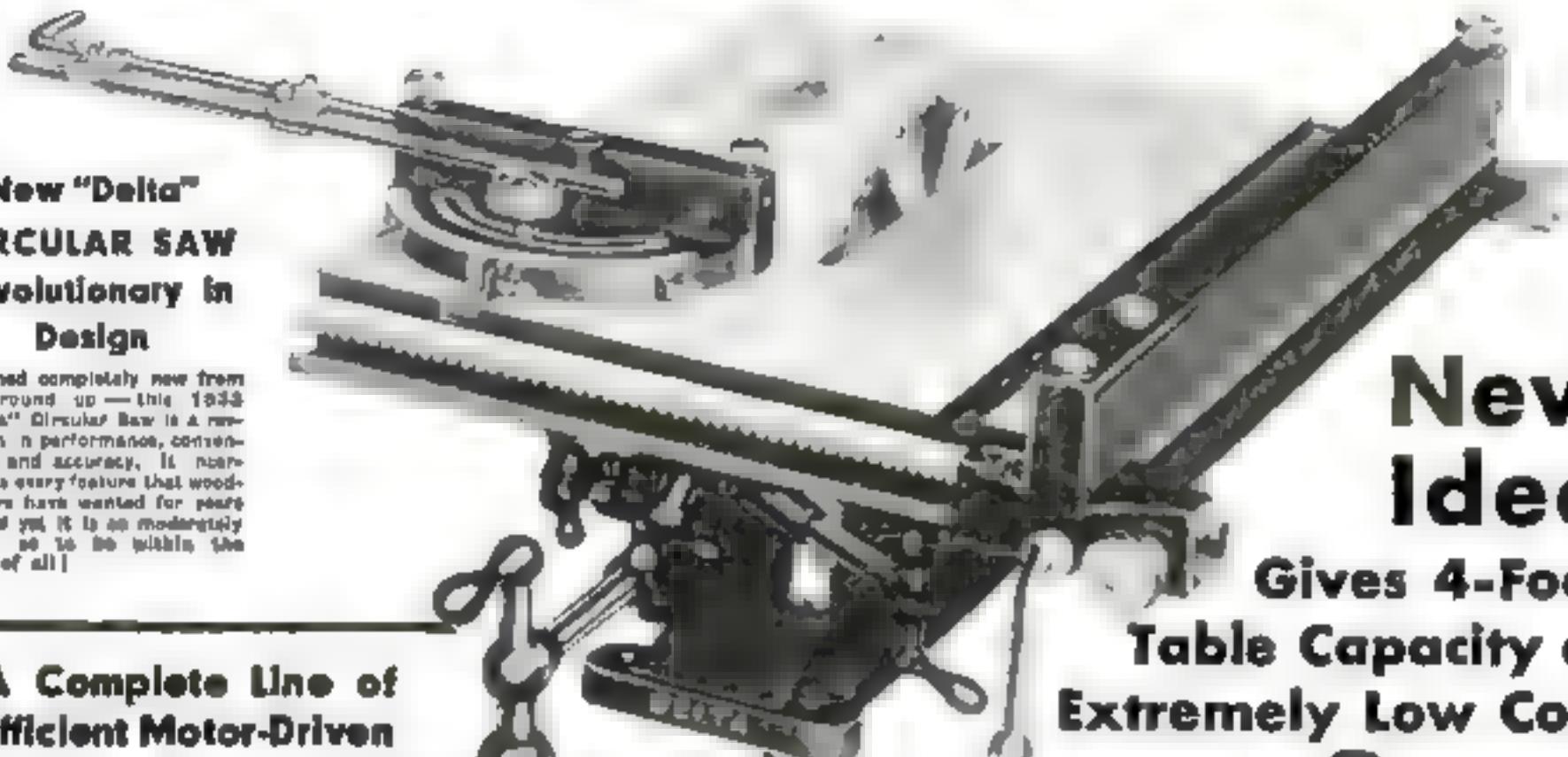
JULY PHOTO CONTEST AWARDS

FOR the best photograph submitted in our July Photo Contest (P. S. M., July '32, p. 94), C. O. Mock, of Lexington, Ky., has been awarded a prize of \$10. The following won honorable mention in the same contest: Joseph Baldorff, Cincinnati, Ohio; Tom Griberg, Moline, Ill.; Forrest Hoff, Jr., Jamaica, N. Y.; William W.

Lange, Chicago, Ill.; P. Paul Lethier, Polaski, N. Y.; Paul Moore, Greenville, Tenn.; H. N. Mucher, Reading, Pa.; B. J. Smyth, Oberlin, Ohio; Robert Stauffacher, Claremont, Calif.; Eddie Webster, Lewiston, Idaho. V. M. Whick, Montreal, Canada. The winner of the August contest will be announced next month.

New 1933 Delta Tools

Set New Standards for Motor-Driven Woodworking Units



**A Complete Line of
Efficient Motor-Driven
Tools for Home
Shops, Factories**

NEW tools, startling improvements, added accessories feature the 1933 "Delta" line of woodworking units. Into each tool has been built the same quality and careful workmanship that has made "Delta" the standard for motor-driven units the world over. The sturdy construction, compact, convenient design, portability and low initial cost make these "Delta" tools equally at home for use in factory production and home workshop. Many thousands of professionals, woodworkers and home craftsman testify as to the splendid performance of "Delta" tools on the most difficult jobs. That's why they say "Delta" offers the most machine value per dollar!

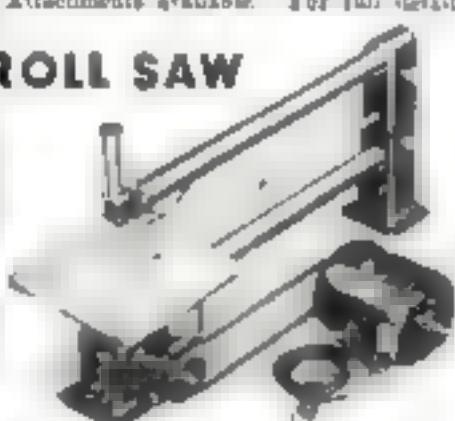
New "Delta" DRILL PRESS

It would take almost a book to describe completely the felt use, advantages, and range of operations of this invention, new addition to the line being the use of the "T" or "Tee" form for carrying the pipe line, which provides a means for turning the line at right angles without the use of valves or fittings, the ends of pipes being joined together by means of sleeves.

Church Training Tables. Known as "4000's" and may be purchased at \$100.00 each. The tables can be returned and used again. A 20% discount will be given. See **Training Attachments** available. For two tables see the New Catalog 1933.

New "Delta" SCROLL SAW

Radically different from any
Brevil Saw on the market. It
has a full width blade, 1500
strokes per minute—soft cutting with
no saw charred. It's perfect
balance and absence of vibration.
As a result the arms hardly
tired after long time although using
certainly a bit harder than hand-saw
or a hand saw. Has 34-inch thread
capacity and will saw wood 2 inches
thick! Works on metal and fibre as
well as wood. Has expensive spe-
cial fasteners. It can be used for
almost sanding and finishing.



New "Delta" COMBINATION UNITS

Delta Combinations. These are convenient, portable and compact. All are built up on beams or frames and are available in a large variety of combinations and at prices fit for every need. These are the combinations of the "T" type. They are described as complete sets in the 1933 "Metra" catalog. The "Delta" combination of open or open bays has a single Westinghouse low voltage motor, a belt drive, a star delta starting device and three phase starters. It can be used for pumping and lifting or dewatering, and a complete line of accessories.



CIRCULAR saw users have a way wanted a large saw table. The 1933 Delta Circular Saw provides this with a remarkable new method this saw table gives both extra space in front of the saw where it is most needed plus all the advantages of a table 4 feet square.

at a fraction of the ordinary cost of a very large table. In addition, this unusual table offers an amazing surprise! It contains a new quad action electronic driving and accurate locking and can not be matched from anywhere else in the market. New features! A table as tall as 4 feet after you sit at it, sitting less than 20 inches above ground. This is Tall top Table design, our tallest yet, but in view of power! For full details send the coupon below today for the FREE 1998 "Lectra Catalog".

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1

111

City

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NOVEMBER, 1932

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DON'T clean a file by tapping it



Impatient tool users have been known to rap their files on the work bench to dislodge the particles of metal or wood which clog the teeth. This method seldom accomplishes the desired results but often injures the file.

Clean your Nicholson Files by using the file card or the file brush. It saves time and saves the teeth of your files.

And clean your Nicholson Files not only at regular intervals but immediately after you have finished each job and are ready to lay them away for Nicholson Files deserve the best care you can give them. They are the highest quality files which modern methods and long experience can produce.

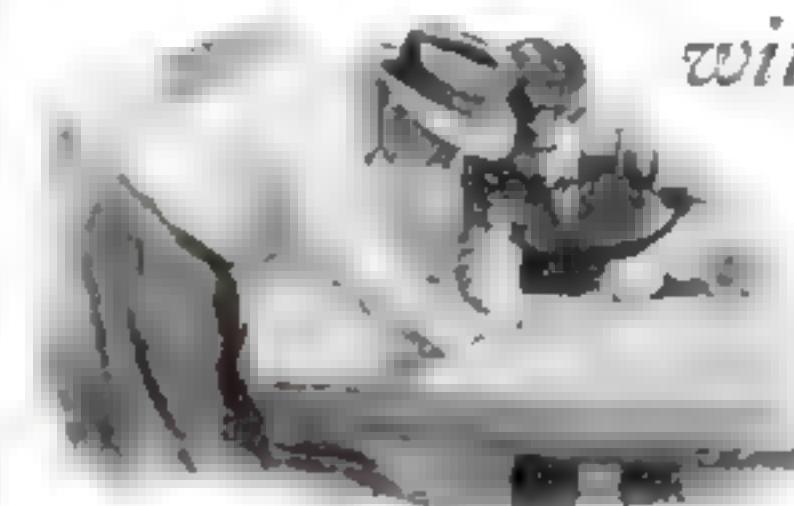
At hardware and mill supply dealers'

NICHOLSON FILE CO.
Providence, R. I., U. S. A.



A FILE FOR EVERY PURPOSE

Covering Our New KAYAK with Canvas



Tacking the canvas along the outside of the cockpit coaming. This can be done more easily if you have a helper.

ONCE you have completed the framework of the new POPULAR SCIENCE MONTHLY 16-ft. kayak, or Eskimo type canoe as described in two previous articles (P.S.M. Sept. 32, p. 57, and Oct., p. 70), the application of the canvas covering is a comparatively simple matter.

Two sizes of tacks will be needed— $\frac{1}{2}$ in. to take the strains and $\frac{1}{4}$ -in. to hold the canvas closely and work out wrinkles. If a piece of 10-oz. duck 60 in. wide can be obtained, it will be ideal, but a length 30 in. wide joined along the keel will serve practically as well.

Sand all varnish off the bottom of the keel and coat the wood well with glue. Lay a strip of the canvas in the glue, carrying the selvage to the far side of the keel, and tack in place every foot or so. Do not stretch too tightly. Apply glue to the edge of the piece tacked to the keel and press an additional breadth in place, lapping it just the width of the keel and tacking with large tacks every 2 in. and with small tacks every $\frac{1}{2}$ or $\frac{1}{4}$ in. Stagger the small tacks, but keep the large ones on the center line.

Starting amidships on the side, pull the canvas over smoothly but not too tightly and tack to the outer face of the wale with large tacks, driven down hard. Work along one side for a few feet each way, then tack the corresponding section on the opposite side.

When the cover has been tacked along the wale to points opposite the ends of the coaming, there will be a gap in the canvas unused. This can be taken care of by stretching the canvas across the deck, meeting in the center.

The finished kayak is laid out of the water. Although it weighs only 25 lb.

By JACK
HAZZARD

Before tacking all the way to the stem head, start tacking along the cutwater, which should be well coated with glue as the work progresses. Tack the canvas from one side first, using small tacks spaced at 1- and 2-in. intervals. Cut off the excess cloth, coat the canvas immediately over the cut-

water with glue, and, folding over the cloth from the other side, repeat the tacking, this time spacing the tacks from $\frac{1}{16}$ to $\frac{1}{4}$ in. apart and driving them in firmly. Wipe off all excess glue and leave $\frac{1}{2}$ -in. of cloth projecting until the glue has dried. The bang plate will cover all the tack heads. Use care in spreading the glue as the paint will not adhere to it very well.

When the cover has been tacked along the keel, stems, and wales, give the inside a coat of airplane dope, being careful not to spread it on the frames or longerons because it whitens the varnish.

Lap the remaining canvas over the decks and glue and tack one side to the ledge outside the cockpit coaming and along the center stringers. In stretching the deck canvas along the cockpit, pull it across the top of the coaming and force it down into the glue spread on the ledge, tacking at 1- and 2-in. intervals with small tacks. Complete the tacking with large tacks and coat the canvas for $\frac{1}{4}$ in. with glue. Cut the excess away with a sharp knife where ledge and coaming meet. The rough edge will later be covered by quarter-round oak molding. Now work out along the center stringers, coating them with glue and tacking as the work progresses.

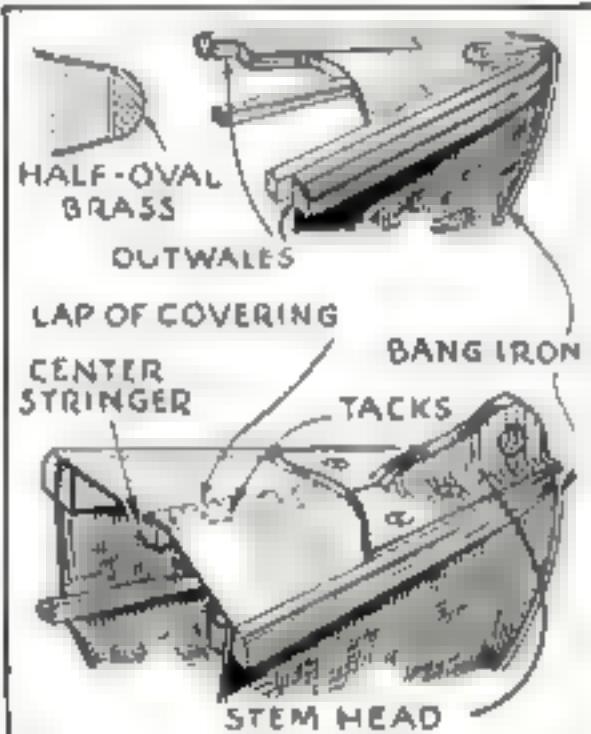
The first pull should be diagonally across the deck and toward the stem. Later remove the preliminary tacks a few at a



time and pull straight across the deck at right angles to the center line. The first pull will develop deep diagonal wrinkles running at 45 deg. to the center out toward the wales and back toward the midship section, but a little pulling and close tacking will eliminate most of these, and the few remaining will disappear when the covering has been doped once or twice.

With one half of the deck in place, cut off the excess cloth, spread glue over the stringer, and fasten the opposite side in like manner, finishing off with a strip of glue all along the center line. Scrape away the varnish around the mast step to provide bare wood for the glue to adhere to.

The hull and deck covering should now have three or four coats of airplane dope, which not only fills the weave of the cloth but shrinks and toughens it as well. Work fast, brushing on the dope much as you



How the half-oval brass bang iron is applied and the stem heads made and fastened.

would lacquer. Provide good ventilation, select a moderately warm day, work inside, and beware of matches or any open flame. A low six hours between coats and sand lightly with No. 0 paper between coats.

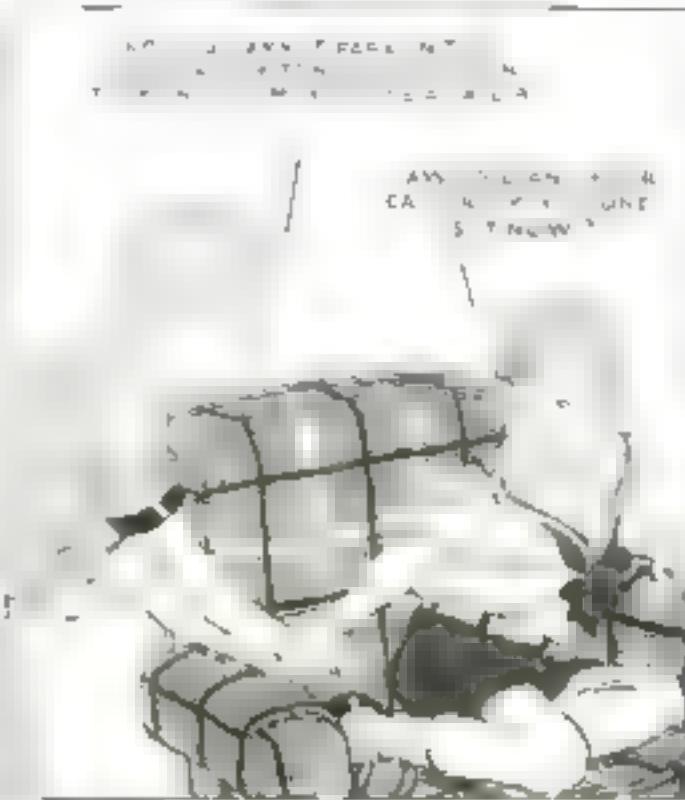
The shoe keel, which was removed before the canvas was applied, is tapered from its full width over the middle 6 ft. to only $\frac{1}{2}$ in. at the joint with the stems, and is screwed firmly in place before the enameling begins.

When the last coat of dope has been sanded smooth, apply a coat of good enamel, guaranteed to withstand water and to adhere firmly to the doped surface. Allow ten hours for hardening. Sand this coat until the higher portions of the weave begin to show as whitish dots, then put on the final coat, taking care to avoid runs and the raising of dust. Spread the enamel quickly, much as you would varnish, but work for a thinner coat.

Bang irons of half-oval brass run for a few inches along the keel and a lesser distance beneath the brass stem heads, where they are thinned out considerably to permit the stem head to come down tight. Drill the end of the bang iron and screw it to the deck, then bend it downward at a right angle and fit it to the stem. Drill,

A "KID BROTHER" PLAYS CUPID

— by Timings

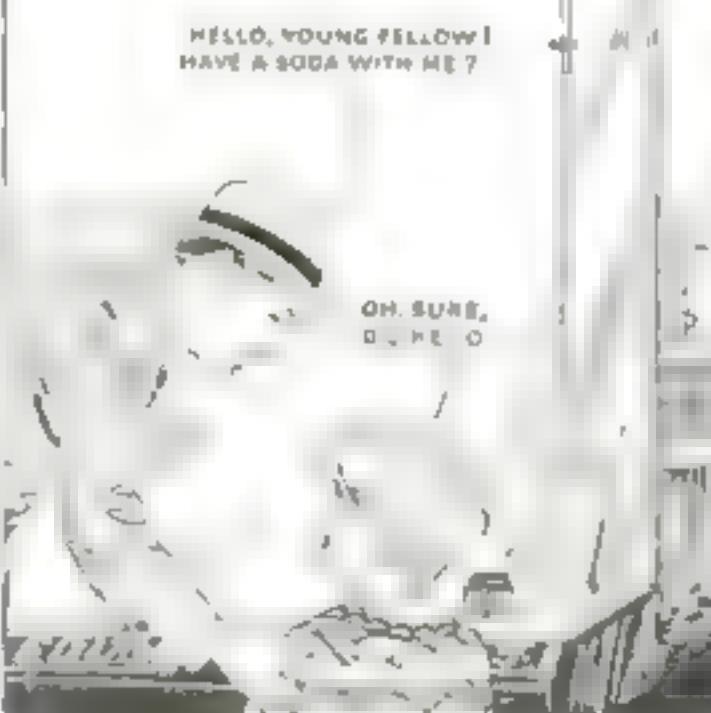


NEXT DAY

I WAS NEVER SO DISAPPOINTED IN ALL MY LIFE, BETTY TO THINK THAT HE SHOULD BE CARELESS ABOUT "B.O." OH, YES, HE WANTED TO MAKE A DATE, BUT OF COURSE I WOULDN'T



NEXT WEEK



LOOK HERE MAYBE YOU CAN TELL ME IF WE DON'T ANYTHING TO DEFEND YOUR SISTER?

WELL THERE IS SOMETHING, BUT SHE'S AFRAID TO TELL YOU... SAY WHY DON'T YOU USE LIFEBUOY?



NO "B.O." NOW

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(body odor)

WE ALL need to guard against "B.O." (body odor). Our pores give off a quart of odor-causing waste daily. Play safe — bathe regularly with Lifebuoy. Its pleasant, quickly-vanishing, hygienic scent tells you this unusual toilet soap does more than merely surface-cleanse. Its creamy, penetrating lather purifies pores —stop "B.O."

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Lifebuoy's bland, deep-cleansing lather frees pores of impurities—freshens dull, cloudy skins. Adopt Lifebuoy today.



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THIS convenient set of eight genuine MORSE tools brings to your workshop the same fine performance which machinists everywhere recognize and admire. Four taps and four drills in corresponding sizes suitable for machine or hand work.

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THE MORSE Extractor removes the broken screw without fuzzy makeshift methods, and without damaging the threads. A handy set is offered for Popular Science readers for \$3.00. Set contains 5 extractors—sizes 1-5—covering most home workshop needs, including full directions for use. Send the coupon and \$3.00 in currency, money order or check.

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Name _____

Address _____



After the canvas has been tacked to the center stringers, rub a liberal application of glue onto the cloth along the seam to reinforce it. This takes the place of folding the canvas

countersink slightly, and nail it in place at 3-in. intervals with copper nails, the heads of which have been removed and the deficiency remedied by tapping the end with a ball hammer until expanded enough to fill the small countersunk hollow in the head iron. The nails should be approximately 1/16 in. in diameter, and 1/4 in. of the length will be needed to work into a head.

The stem heads are made of 1/16-in. sheet brass, sawn to shape on a jig saw, or back sawed and filed. To get a sharp bend without marring the brass, place the blank in a strong vise, with the line along the bend just at the edge of the jaw. Placing the end of a block of hardwood against the protruding section, drive it over with strong blows of a weighty mallet or hammer.

When the matching pieces have been bent, fit the faces tightly by filing away interfering portions. Tin the inner faces with solder and, holding the pieces firmly in place with pliers, heat them over a gas jet or Bunsen burner until the solder runs. Cool quickly and file away the excess solder. Drill and countersink the screw holes.

Little strain will be placed upon these pieces, but it is well to run bolts through the inboard holes of each head, piercing the wales. To accomplish this it is necessary to fit the stem heads before applying the decking. Bore for the bolts, which need be only 1/8 in. in diameter, smear a bit of waterproof cement around the underside of the hole, and turn the nut against it. When the head is removed, the nut will be held by the adhesive, and will still be there after the decking has been stretched in place and the time comes for placing the stem heads.

The king planks are made of 3/4-in. maple. They are cut and fitted before the paint job is started and, as is the case with the outwales, given several coats of varnish and laid away for application after all else has been completed.

Suggestions for making the sprit, sail, leeboard, double-blade paddle, cockpit cover, and cockpit tent will be given next month. All these embody excellent ideas Hazzard has developed in many years' experience. He regards this kayak as the best canoe for one-man, double-blade cruising and for getting about generally.

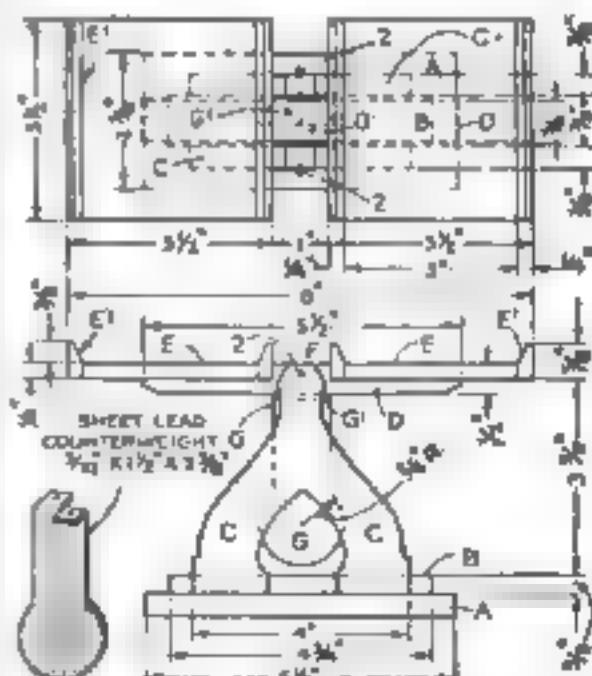
TOY WEIGHING SCALES MAKE IT MORE FUN TO "PLAY STORE"



CHILDREN find it much more fun to "play store" if they can weigh out the "groceries," "hardware," and other commodities on toy scales that work like the real ones on store counters. Balance scales for this purpose can be made with very little work as shown in the drawings below.

Make the base *A* 3 1/2 by 2 3/4 by 5 1/4 in., part *B* 3 1/2 by 3 1/2 by 4 3/4 in., and the two supports *C* 3 1/2 by 4 by 4 in., shaped about as shown. Assemble these parts with glue and brads. Make arm *D* 3 1/2 by 3/4 by 5 1/4 in., and cut it out to allow the center to be flush with the scale pans *E*, as shown at *F*. Bore the 1/8-in. holes marked 2 accurately through the supports and arm *D*. Then make two pans 3 1/2 by 3 by 3 1/2 in., and four lips *E* 1 1/2 by 3/4 by 3 1/2 in. Glue and brad these parts together in the manner indicated.

Make the counterweight *G* of sheet lead. Cut down 3 1/2 or 5 1/2 in. on the center line at the top and turn ears down at *G*. Drill holes through the ears and fasten to the underside of *D* in the exact center. For the pivot shaft use a piece of steel wire smaller than the holes 2 so that the pans will respond to the least touch, and balance them either by boring holes, trimming the lead counterweight, or turning in screws to add weight. The pans must be level when at rest.—D. W.



Top and front views of the toy scales and a sketch showing the sheet lead counterweight

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SERVICE
MANUAL

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THE BRUSH—Wooster Shortette, $1\frac{1}{2}$ " width, with pure Chinese bristle—great for painting small objects, such as trim, touch-up jobs, etc. Foss-Set—Guaranteed use in anything—bristles won't come out!

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THE MANUAL—Contains valuable information on how to get better finishing and decorating results. Edited by F. N. Vonderwalker, famous practical authority. Actually worth dollars to you.

Only 35¢ to cover cost of shipping before this extra special introductory offer. Send now!

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The Wooster Brush Co., Wooster, Ohio
Enclosed please find 35¢. With my application send the Foss-Set PAINTER'S SERVICE MANUAL, the 1st package of BRUSH CLEANER By WOOSTER and the Painter's Service Manual.

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Address _____

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HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk *

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means

that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

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Bark, Seine Half Model, 108	25
* Battleship U. S. S. Texas (3 ft. Hull), 197-198-199-200	1.00
See page 94 for kit of materials	
Bottle, Copper Ship, n. 121-122	50
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Copper—Sovereign of the Seas, 51-52-53-R	.00
Constitution ("Old Ironsides"), 37-54-59-R	1.00
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Destroyer—U. S. S. "Kearny", 125-126-127-R	1.00
Galleon, Spanish Treasure, 46-47	50
See page 94 for kit of materials	
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Motorboat, Working Scale Model Driven by Rubber Bands or Toy Outboard Motor, 20-in. Hull, 1-194	.25
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PULL ON CORD UNLOCKS DOOR DOWNSTAIRS

IN MANY small houses there are stairs leading from the side entrance up to the kitchen. When someone knocks or rings at the side door, whoever happens to be in the kitchen has to walk down to unlock the door. To save these unnecessary steps, I rigged up a simple device for unlocking the door from the kitchen.

Two holes were drilled into the knob of the night latch on the door, and these



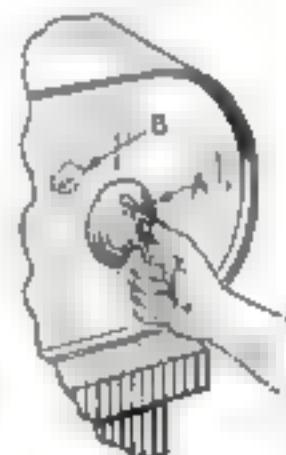
Side door of house with night latch arranged so that it can be unlocked from the kitchen.

were tapped to take No. 8/32 machine screws. A metal strip about 6 in. long was then screwed to the knob, and a piece of strong cord (flexible picture wire could also be used) was led from a hole in the outer end of the strip to the kitchen through a pulley fastened to the door as shown and through several screw eyes on the wall.

Pulling the wire unlatches the lock, and the door then can be pushed open. A spring arranged as indicated returns the lever to its original position so that the door will automatically lock itself when closed.—VALENTINE ESPER.

TESTING SOLDERED WORK FOR PINHOLE LEAKS

SMALL soldering jobs on gas tanks, pipes, kitchen utensils, and similar smooth surfaced articles can be tested quickly and easily with the aid of a large vacuum cup such as used to support clothes books. The vacuum cup is slightly dampened and placed over the patch of solder as illustrated. If there is any leakage whatever where the article was soldered, the cup will quickly salt off.—M. G. WINTERTON.

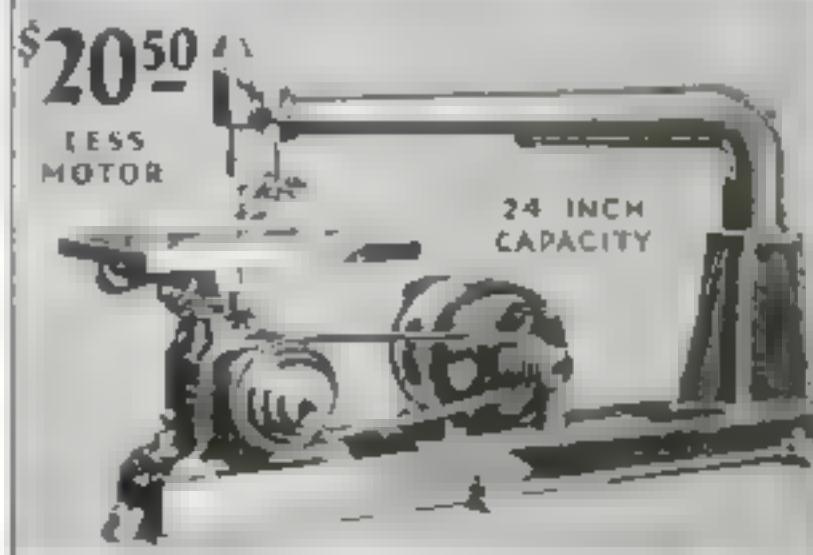


Applying cup A to test solder at B

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short articles, hints, and suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words. Payment will be made upon acceptance for all available material.

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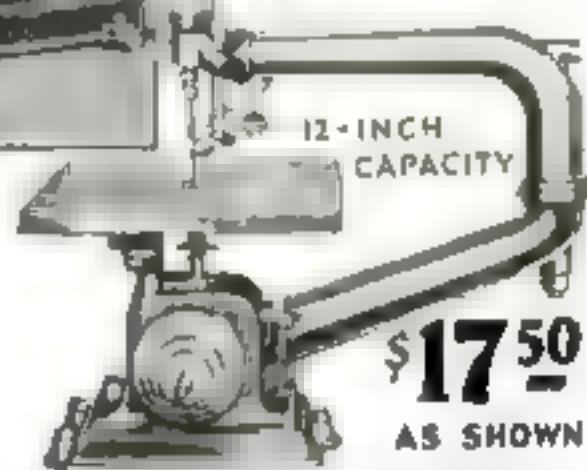
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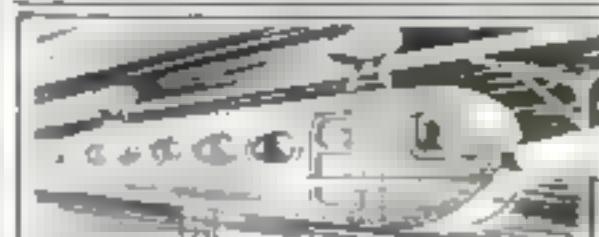
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CARBON EXPERIMENTS FOR HOME CHEMISTS

(Continued from page 61)

A small arc lamp can be made by mounting two binding posts of the Fahnestock type on small strips of wood six inches long. The outside clips hold the lengths of graphite while the others serve as connections for the leads from the current supply. The two strips of wood are then nailed or screwed to a wood block as indicated in Fig. 4. Being pivoted, they can be moved easily for adjusting the arc.

To operate the lamp, connect the heating device in series with the two carbons as shown in Fig. 4, touch the two carbons by moving their supporting sticks, and turn on the current. The electric appliance will heat up in the usual way and the pencil leads will get hot at their tips. The points are then separated a trifle, causing the carbon to burn in the air with the result that the temperature at the ends is raised and the carbon vaporized. The current now passing through the vapor causes it and the ends of the carbons to glow with a white heat. For a more brilliant arc, the carbon rods taken from discarded flashlight cells can be substituted for the pencil leads. However, when this is done, it will be necessary to alter the resistance of the circuit.

GUS TELLS HOW TO INSPECT STALLED MOTOR

(Continued from page 66)

front seat of the stalled car. A few tries with the starter and the motor ran sweetly.

"By rights," said Gus, "those points ought to last you four or five thousand miles without any attention. If they do go bad before that and your motor begins to set up, you can bet your bottom dollar it's the condenser."

"Fixing out what's wrong with a motor that dies suddenly on the road is easy if you'll only remember that two things are needed to run an automobile—gasoline and electricity. Try one, then the other, and it's a cinch you'll locate the trouble."

"But, Gus," inquired Joe when the two garage men were again on their way to the railroad station, "that bird's car didn't look more than a year old. How come the condenser burned out so soon?"

Condensers are funny things," said Gus. "Sometimes they'll last forever and sometimes they'll go on the bum in a couple of weeks. You just can't depend on them. That fellow's condenser was only partly gone, but it was bad enough to burn down the points after a while."

"The tough part of it is, condensers aren't something the average man can fix, so when you're miles from nowhere and haven't a spare one with you, the nearest garage ticks you for the price of a tow. I've carried a spare in every car I've owned. I've never had to use one, but when I do it'll be there—and worth its weight in gold."

HEAT EXPANDS REAMERS THAT CUT UNDERSIZE

Making a solid reamer cut oversize by inserting wire of the proper size in one of the holes in a good emergency tank, but many times it makes the hole larger than required unless there is a great variety of wire on hand from which to choose. Usually this experiment is used because the reamer itself is undetectable. It has been the writer's experience that a better remedy in such cases is to reheat the reamer to hardening temperature inside a pipe, quench it quickly, and then temper it. After the process is finished, the reamer should be rebored. Two reamers which were retrieved in this manner by the writer expanded between .001 and .0015 in.—A. L. EVANS.

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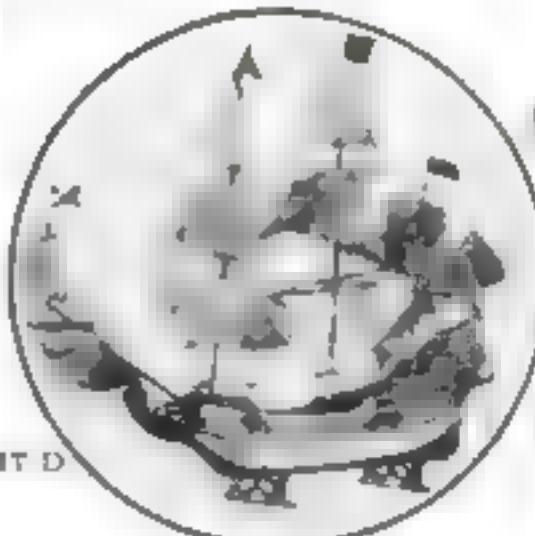
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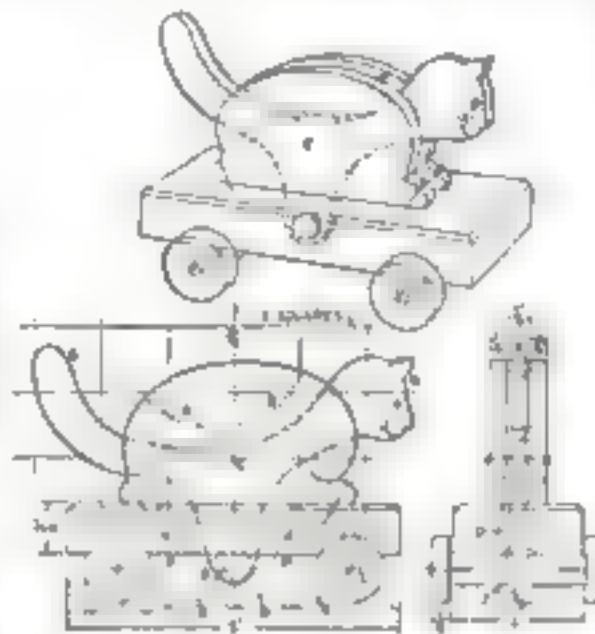
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AMUSING WOODEN KITTY NODS CONTINUALLY

THIS nodding kitty toy may be easily made with the aid of a jig, scroll, or coping saw. Prepare pasteboard patterns of the sides, the back filler piece A, and the combined head and tail piece B by drawing a series of 1-in. squares and reproducing the curves in their correct relation to the squares. Cut the patterns to these lines, lay them on $\frac{1}{4}$ -in. thick pieces of pine or other easily worked wood, and mark around them. Saw closely to the outside of the lines, making the edges square in all cases. If a motor-driven saw



Side and end views of the toy and a sketch to show at a glance the method of assembly

is used, the two sides may be fastened lightly together and both cut at once, which will insure uniformity.

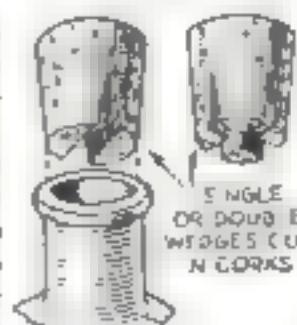
Mark center C accurately on the side-pieces and also on B, and drill a $\frac{1}{8}$ -in. or smaller hole in all three. Assemble the sides and A with glue and brads, being sure that holes C line up properly. Add two $\frac{1}{2}$ -in. disks of lead at the lowest point of B to give it more weight.

Make the body of the truck $\frac{1}{4}$ by 2 by 5 in., and cut the rectangular hole D, $\frac{3}{8}$ by 2 in., through it as shown. Cut two pieces $\frac{1}{2}$ by $\frac{1}{2}$ by $\frac{3}{4}$ in. and fasten them as indicated beneath the body with glue and brads. Make wheels of 1 in. diameter wood, drill $\frac{3}{16}$ -in. holes through the centers, and fasten them loosely with $\frac{1}{4}$ in. $\times \frac{1}{2}$ in. screws.

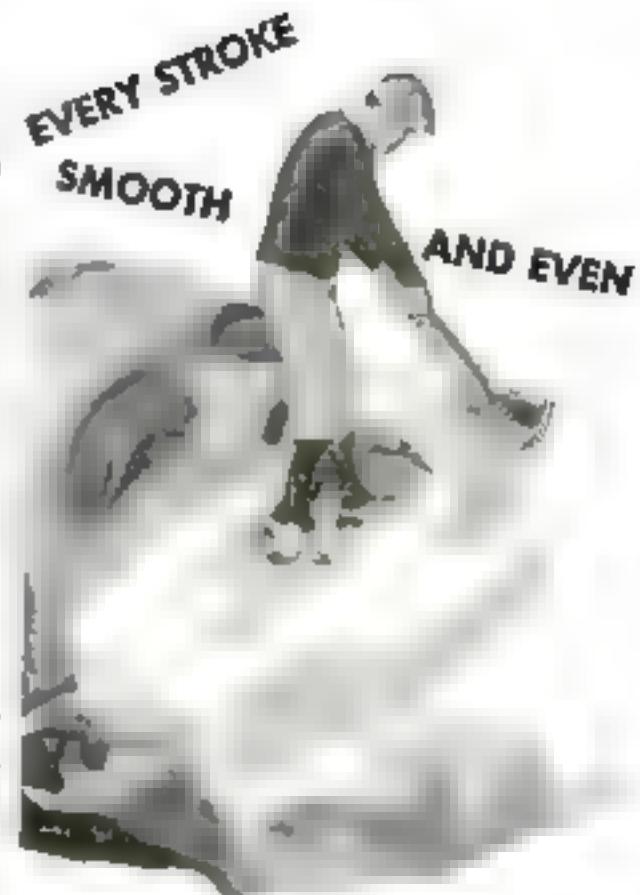
Assemble kitty by pushing a piece of wire or a slender cotter pin through holes C, place bar so the center lines coincide with those of the truck and fasten the side-pieces to the truck with glue and brads. Paint the cat as desired and decorate the truck with gay colors.—C. K.

ADAPTING LARGE CORKS TO SMALL BOTTLES

An oversize cork may be reduced in size by rolling it under a heavy weight or shaving it down under water, but an easier method is to cut one or two wedges from the smaller end as shown.—W. L. F.



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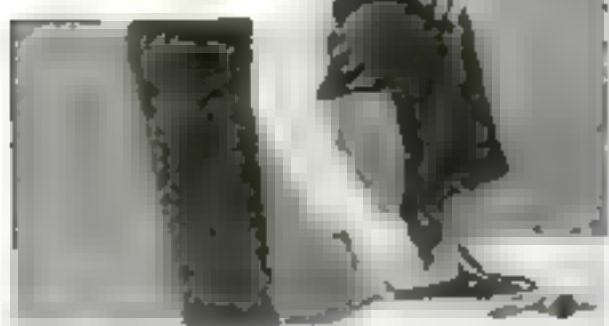
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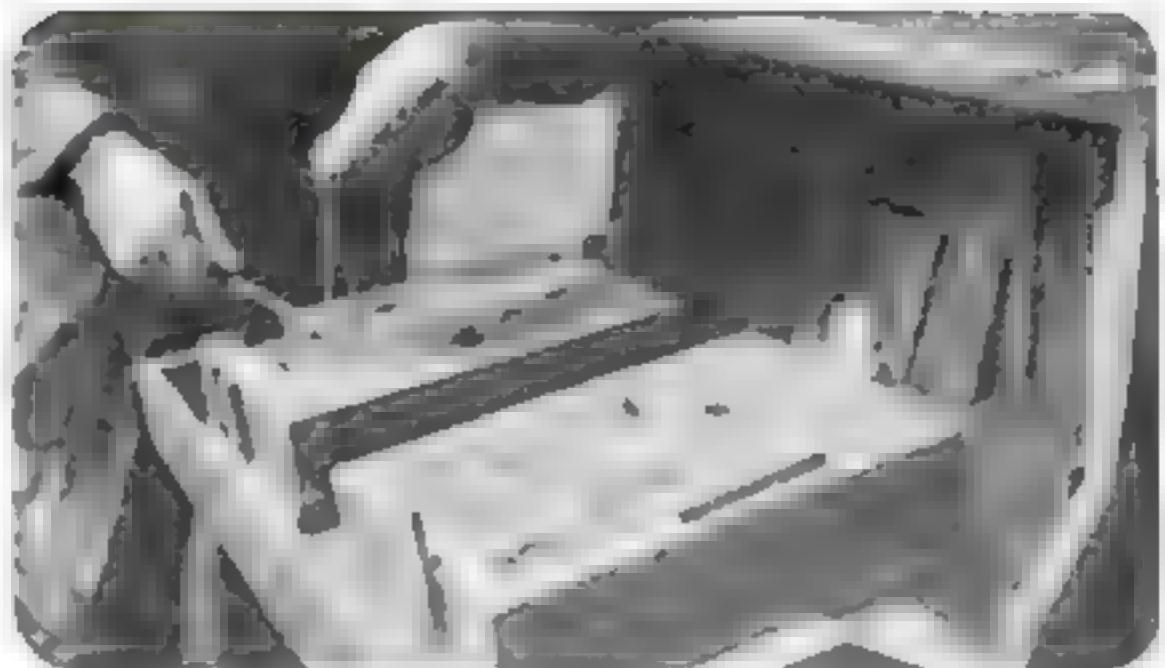
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Drawing a pattern gently out of a mold after the cope has been rammed up

Molding Equipment for Making Small Castings at Home

BY JOSEPH C. GILBERT

EQUIPMENT for making small castings from lead, type metal, aluminum, and other nonferrous metals can be prepared so easily and at such low cost that there is no reason why the model maker or experimenter cannot do his own foundry work at home.

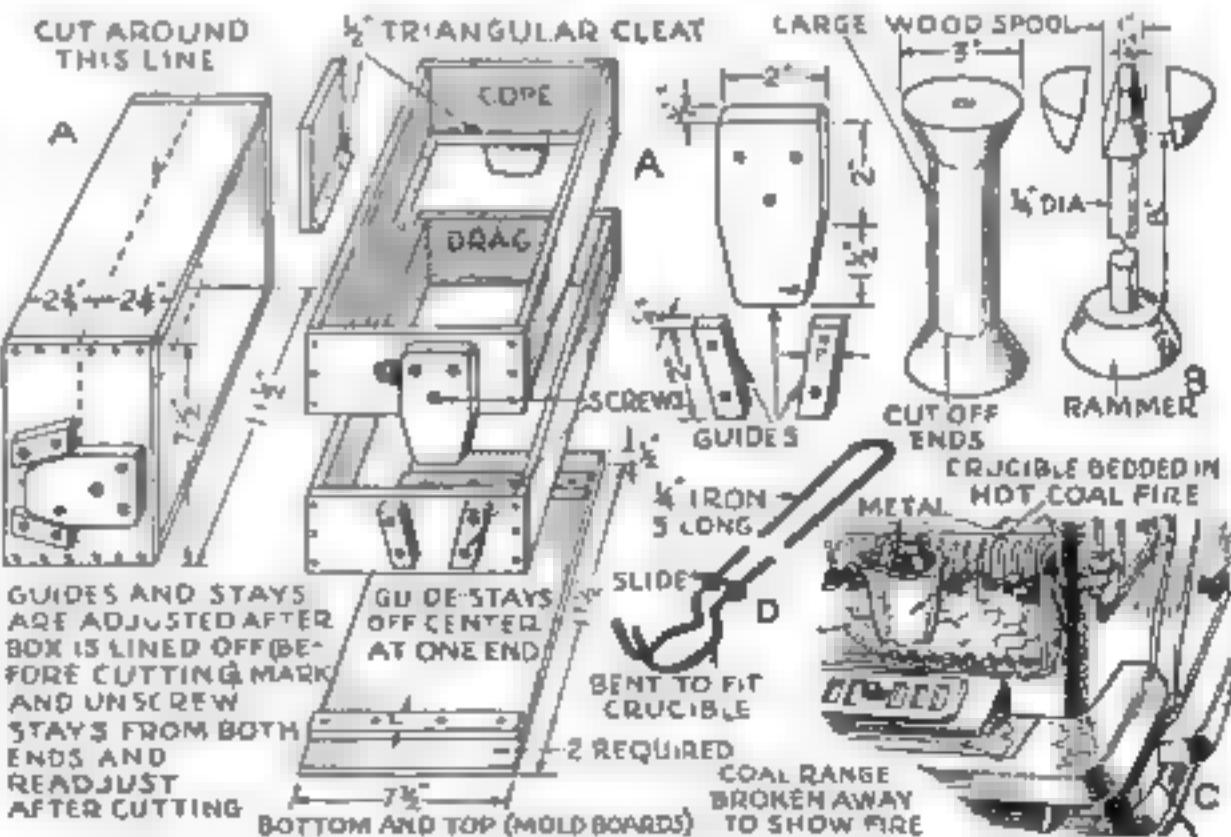
First of all, of course, you will need some sort of box or cabinet to hold your outfit and a small sand bin. These were described in a previous article (P.S.M., Oct. '32, p. 93). The molding equipment proper consists of the following:

A flask or box made of $\frac{1}{2}$ -in. stock as shown at A in the drawings. Fasten guide blocks and stays at each end with screws. Have one set of these off center so that the flask can be closed only one way. Nail

a $\frac{1}{2}$ -in. triangular cleat along the inside joint edge of the cope or top member to retain the sand.

A small scoop of the ten-cent variety and a 10-qt. pail full of fine molding sand, obtained from a local foundry supply store or foundry. If you get it from an iron foundry, ask for new, fine bench sand. Do not take the black or used kind from an iron foundry. On the other hand, if the sand is obtained from a brass foundry, the used sand with one-quarter of the amount of new sand mixed with it makes the best sand for molding. Do not use French sand from a bronze foundry; get the architectural or red sand.

Parting sand. A good handful of sea coal (crushed charcoal dust) or coarse



Equipment needed for foundry work at home. The flask is made as a unit, and the guides and stays are screwed on, then the stays are removed from both ends until the box has been cut in two



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Desk Ornament Predicts Weather

THIS little desk or table barometer is a violin string, which, twisting and untwisting according to the dampness of the air, turns an indicating dial. The materials can be obtained for a few cents.

To make the base, screw a piece of $\frac{1}{2}$ by 4 by 4 in. hardwood to a faceplate, turn it to diameter, and surface it. After turning the molded edge and the $\frac{1}{2}$ -in. center hole, sand the piece smooth.

Remove the base from the faceplate, substitute a larger block of wood, and recess the front to receive the base snugly. Insert the latter bottom side out so that it projects about $\frac{1}{16}$ in. Hollow it as shown and turn the shoulder to take the cardboard bottom. Remove and cut the "window" through which the weather indications are to be read.

Make the column from a square piece of hardwood, boring it in the lathe with a $\frac{1}{2}$ -in. bit. While still on the bit, lash one end to the drill chuck with wire, mount



A violin string is the heart of this barometer

the faceplate with its wooden chuck on the tailstock, and force the point of the bit into the chuck to steady it. After this has been done, the outside of the column can be turned. Turn a cap to fit.

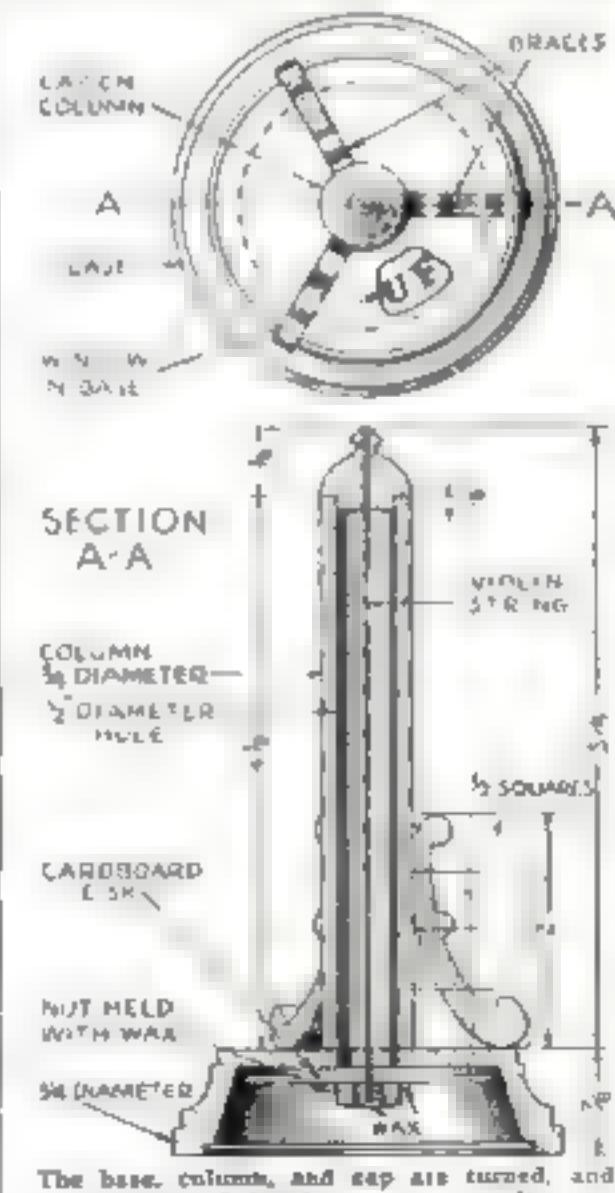
Three brackets, to be set around the column at 120-deg intervals, are laid out on cardboard by sketching the outline through $\frac{1}{2}$ -in. squares. Tack the pattern and three thicknesses of stock together with brads and saw out on a jig saw. Sand smooth and glue them and the column to the base. Finish the case with lacquer, enamel, or varnish before installing the mechanism.

Cut a piece of violin string 8 in. long. Thread one end through the center of a heavy cardboard disk, securing it on the underside with melted sealing wax. Press into the wax a $\frac{1}{2}$ -in. nut or other weight to hold the string straight. Thread the other end of the string through the column and a small hole bored in the cap, where it is glued when the disk hangs $\frac{1}{16}$ in. below the inside of the base top. To increase the circulation of air in the column, drill a small hole in the top near the cap.

Instead of waiting for the weather to change to get the calibrations on the dial soak the inside of a cardboard box with water and set it over the barometer for a couple of hours, rewetting it occasionally. Then mark an "S" on the disk in the center of the window for stormy. Now stand the gadget on a warm oven, or in bright sunshine if the day is dry and warm, and let the dial shift as far as it will. Mark the new point "F" for fair. Midway between put a "U" for unsettled. These markings can be inked in as elaborately as desired.—Eowix M. Lovz.

FILLING HOLES IN WOOD

WHEN it is desired to force a plastic wood composition or wood putty into a hole and let it dry under pressure, put a piece of waxed paper between the work and the block before clamping. The waxed paper not only will peel without dragging out the plastic material, but also will not absorb the moisture from the surface, causing it to dry too rapidly.—C.M.B.



FAN WHITTLING STUNTS

(Continued from page 75)

bird or a flying fish with wings and tail formed as fans. The tails and wings will be in reality the same fan, the division being attained by bending one blade each way alternately instead of forming them as a single spread. This requires a well-soaked piece and careful splitting to the notch.

If more complicated applications of fan whittling are desired, Fig. 4 provides an idea—a bird in a cage with fan wings and a tail on the bird. This is my own adaptation of the ball-in-a-cage stunt. The method of forming the fans is shown in the drawings at F. Bird, wings, tail, and cage are, of course, all whittled from the same piece.

The little lady of 1860 or thereabouts, complete as to skirt, overskirt, flounces, tip-tilted hat, and bouquet, is likewise of one piece of wood. The left-hand photograph in Fig. 1 shows her before the cleaning up process incidental to finishing. If desired, she might be colored with oil. Details of her construction are shown in the drawings at G. The important thing to remember is that fragile or unsupported sections should not be completed until all rough cutting has been done. Thus the fan in the lady's hand should be whittled out just before the blades are split. Since the grain of the wood runs across her body, great care must be exercised that her head or arms is not broken off.

It is essential that the notches for the skirt fans be brought as close together as possible in order that they may present an unbroken skirt line at each side. It must be remembered, however, that bringing them too closely together will cause the stem to break off when the blades are split, or possibly may cause the stem to be split across as the leaves or blades are separated. This fan also differs from all previous ones in that the blades, when brought to place and strung together, are bowed downward and pulled in to form the skirt. This must be done carefully while the piece is very wet.

Similar projects might include a Christmas tree, a floor lamp, an umbrella, an Indian chief and his headdress, a ballet dancer, a Hawaiian belle, perhaps even a Liberty Bell, and so on. Another fan project that offers considerable fun is the fan in a bottle shown in Fig. 3. This is produced by taking a piece of wood small enough to enter the bottle neck, forming the fan completely, straining it, then folding it just as a lady's fan is folded and inserting it through the neck into the bottle. It is reopened with long wires and held until it dries. The second little fan below is just an added complication.



Fig. 3. A double fan in a bottle



Fig. 4. Bird and cage in one piece

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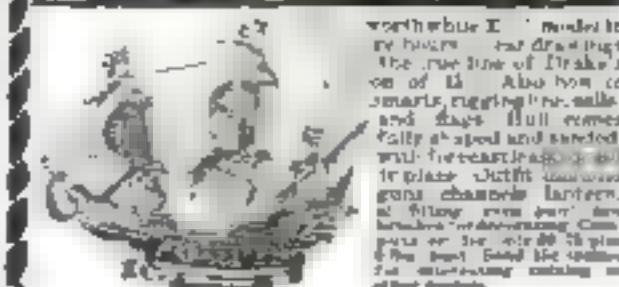
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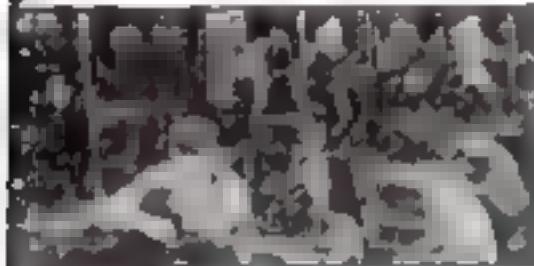
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Secrets of Success HOW AMERICAN WAR ACE BEAT HIS HANDICAPS

(Continued from page 100)

Rickenbacker was growing up in a changing world of automobiles and he charged into the expanding industry with characteristic vigor. His days were consumed in work that brought out the best in his head and hands. But his nights were free—and thus spare time he devoted to the study of engineering principles. At twenty he had the title of experimental engineer.

The next six years were devoted to gathering an ever widening experience in the automobile world. He started out as a racing driver and won many national and international trophies. He went out to sell cars—and did. With the practical knowledge thus gained, he called upon his inventive talents and became the designer and manufacturer of a low priced car.

Then came the War. Eddie Rickenbacker accompanied General Pershing to France as a member of his automotive staff, but at his own request was soon transferred to the Air Service. He was a member of the famous 94th Aero Pursuit Squadron and finished the War with twenty-six victories—the finest record of any American aviator. Today he is vice-president in charge of sales for the Fokker Aircraft Company, a General Motors unit.

In the story of this man, one thing is evident. It could be almost any one's story—that is, the story of any one with a definite goal and definite determination to reach that goal. Essentially it is the story of a man who was willing to concentrate every effort, every spare minute to gain his goal.

WILLIAM RILEY COPPAGE USED HIS SPARE TIME

UNTIL he was eighteen years old William Riley Coppage had never been further from Lebanon Junction, Kentucky, than Tullahoma, Georgia. Today Riley is one of the best known names in the construction game.

As a youngster, Coppage could read and write and figure a bit, but his main asset was his broad, strong back. That six foot one frame of his was "rarin'" to go. His father's farm was too small to hold him and out into the world he went. His first job was with the Southern Railroad. There when he was twenty-one Riley helped build wooden bridges along Dixie's rights of way. The gang lived in box cars, cooked meals at camp fires in timber or swamp edge—and worked. Muscle was all that Riley got out of that life. He grew discontented. He wanted something more.

His next job was an apprenticeship with a Philadelphia bridge company, and here he found his life's work. Thereafter he followed steel. The trail led to field jobs for railroads, bridge and ship builders and general contractors all over the country. He could handle men, as his various employers soon (Continued on page 103)

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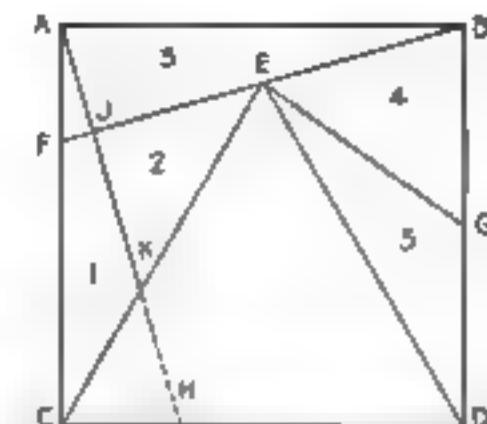
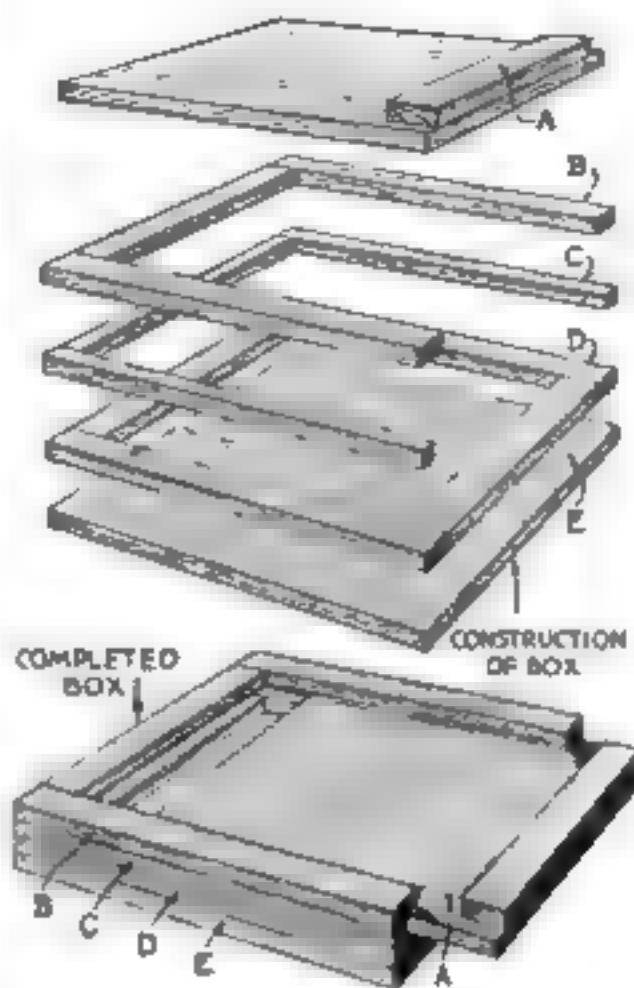
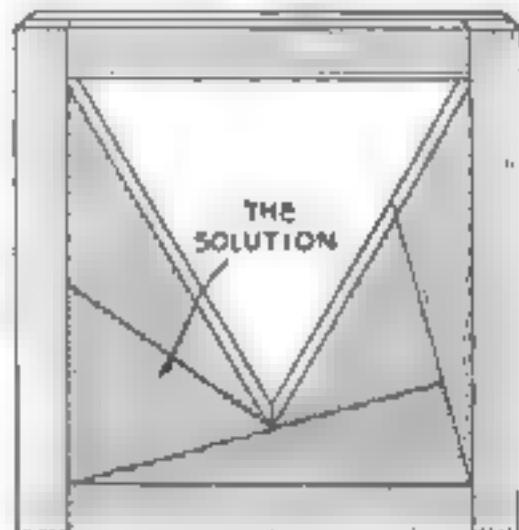


DIAGRAM FOR LAYING OUT THE TRIANGLES



This puzzle, devised for Popular Science Monthly readers by one of the foremost experts, is deceptively simple. Five pieces have to be arranged to form an equilateral triangle.

AN UNUSUAL cut-out puzzle with a "catch" in it may be made from cigar-box material as shown in the drawings above.

The problem is to form an equilateral triangle in a square box or frame by using five pieces of the shapes indicated. The solution depends upon the fact that the triangle is formed by the space left when the pieces are correctly assembled. Anyone with an instinct for solving puzzles is likely to suspect this trick, but even then it is rather troublesome to assemble the pieces.

Either a frame should be made to hold the pieces, or a box. An easy way to make a box with a sliding cover is illustrated. The base *E* is 5 in. square; frame *D* is made of strips $\frac{1}{2}$ in. wide glued to *E*; frame *C* consists of three strips $\frac{1}{4}$ in. wide glued to *D*; and frame *B* is made of strips $\frac{1}{8}$ in. wide. The gluing

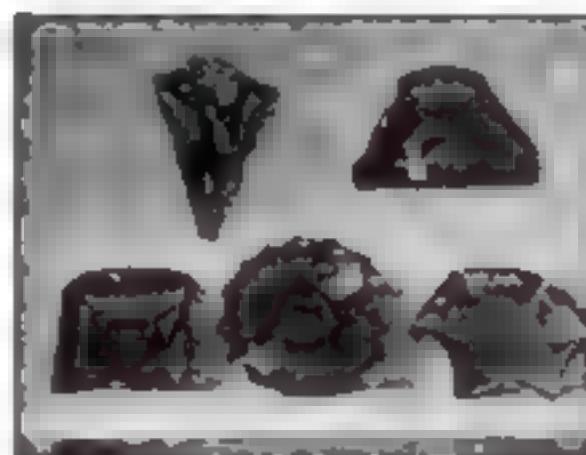
cover *A* is $4\frac{1}{4}$ by $4\frac{1}{2}$ in., and the strip glued to the top is $\frac{1}{8}$ by 4 in. The inside bottom of the box may be painted white or some other color, and the outside parts sandpapered, stained, and waxed.

Five triangles are cut out of material the same thickness or slightly thinner than that of frame *D*. The diagram shows how they are laid out. Draw a 4-in. square accurately on cardboard. The equilateral triangle *CED* is erected on the base. Through points *B* and *E* the line *BF* is drawn. *AF* is found by prolonging *BF* to *F*. *CH* equals *AF*. Line *AK* is drawn from points *A* and *H*. This makes the triangles 2 and 3 right angled. It is a little more confusing to assemble the parts if they are so. *EG* is drawn to the middle point of *BD*.

Using 1, 2, 3, 4, and 5 as templates, cut out the wood parts and sandpaper, stain, and wax them.—ARTHUR L. SMITH.

NOVELTIES MADE FROM PHONOGRAPH RECORDS

Old phonograph records can be converted easily into novel wall pockets, card trays, paper clip holders, and small receptacles for various purposes. Place the record in a large pan of boiling hot water and let it soak for a few seconds. It will become soft and pliable enough to be shaped with the hands. The shaping must be done immediately upon removing the record from the



Phonograph records modeled into odd shapes

water, and it will be necessary to immerse it several times during the process to keep it sufficiently soft and pliable.

After the record has been shaped, it may be decorated to suit the fancy, but it is best to leave the label frankly in the center and apply any ornamentation around the edges. Not all records will respond to this treatment, but the majority can be softened.—PAUL HADLEY

SPOT CROOKS BY THEIR EARS

(Continued from page 22)

However, a detailed comparison of the ear on the unknown corpse with Foster's ear, as shown in rogues' gallery side views, proved the dead man was not the wanted gangster and the hunt for him continued.

At various times, such comparisons have played a part in solving crimes and sporadic investigations of the ear as a means of identification have been carried on in different parts of the world by criminologists. But, no one had thoroughly explored the possibilities of the subject until Dr. Kilmer began his decade-long research. And, the most sensational phase of his work remains yet to be described!

A little more than a year ago, he was running over pictures in a rogues' gallery when he was struck by a surprising thing—the large number of protruding flap ears. Taking out a pencil, he tallied up the number of flap and close ears with little marks on a sheet of paper. The flap ears reached such an unexpected total that he called the fact to the attention of an officer.

"How do you know there aren't just as many flap ears among honest people?" was his comeback.

"That's just what I intend to find out."

TO DO this, the doctor obtained permission to go over hundreds of passport and other identification photos of men well known for character and honesty. He selected approximately the same number of honest pictures as there were criminals represented in the rogues' gallery. When he finished his flap ear census, he added up the totals and found that twenty-three percent of the honest persons had such ears, while among criminals of all classes the average was forty-four percent, a ratio of practically two to one!

Striking as this fact was, it was infinitely less amazing than the result of the next step in his investigation.

Going back to headquarters, he again went over the pictures of the known, hardened criminals dividing them into groups according to the crimes for which they had been sentenced. Then, he worked out the percentage of flap ears among auto thieves, stick-up men, burglars, jewelry thieves, kidnapers, forgers and swindlers.

Nearly sixty-four percent of the auto thieves had flap ears; more than fifty percent of the stick-up men; approximately forty-eight percent of the burglars, and more than forty-five percent of the jewelry thieves. At the bottom of the list were the forgers, with about twenty-five percent, and the swindlers, with only sixteen percent.

Why do people have flap ears and why is the thief more likely to have them than the swindler or the forger?

DR. KILMER has a theory growing out of his years of medical practice during which he treated babies in the tenements and babies in the homes of millionaires. Children given the least attention, he noted, were most likely to develop protruding ears because they often slept on them while folded over. The life history of criminals almost invariably shows they also were neglected in childhood. There is a definite link, Dr. Kilmer suggests, between crime and flap ears. The same environment that breeds the former produces the latter.

During the next few years, Dr. Kilmer intends to carry his unique researches still further. The results will be watched with keen interest by officials all over the country. One of the next important steps in criminology may be the application of the findings of this doctor to the science of catching crooks.

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FIGHTING THE SEA FOR WRECKED SHIPS

(Continued from page 53)

cut through the bulkheads with the then newly invented oxy-electric torch.

This torch differed from the ordinary electric torch in that the arc burned in a powerful jet of oxygen, supplied from cylinders. The terrific heat caused by the current produced a protecting bubble of steam around the flame; from the glare of which, even in the thick muddy darkness, they were compelled to protect their eyes. The torch worked perfectly—cutting steel plating, half an inch thick, and buried under silt water, like wax.

After holes had been cut through the bulkheads, twenty-one giant legs, built of thirty-foot steel girders, were erected on the side of the ship. Beside the next pier were sunk twenty-one great concrete blocks. Then steel rigging was strung from the legs to tackle on the blocks and to twenty-one steam winches. For a week they tugged away slowly. Pumps capable of handling more than a million gallons an hour began throwing out water. Finally the *St. Paul* floated.

The most southerly base of the Black Fleet on the Pacific coast is at San Pedro, Calif. But from there was quickly sent the crack salvage ship *Peacock*, to the aid of the *S. S. Steelmaker*, grounded on the rocks off Nukulaelai Island, 700 miles south of the Equator.

UPON arriving, no vagr engineers determined that the *Steelmaker* would have to be removed from her dangerous position on the rocks before she could be repaired. Pumping the water from her holds with a battery of submerged pumps, and taking advantage of the lift of the tide, she was worked clear of the reef. Still pumping, against the rush of water through twenty-seven gaping holes in her side, the damaged ship was towed 700 miles north to the calm harbor of Pago-Pago, Samoa.

There, three divers from the *Peacock* measured the holes, applied wooden forms constructed on the salvage ship to their specifications, and dumped in these forms with concrete lowered in canvas bags. After overhauling the engines, the *Steelmaker* was navigated by salvage officers, under her own steam to a dry dock in New York. In making the return trip to this rescue, the *Peacock* had sailed 9,727 miles—the longest salvage trip on record.

Occasionally comes that most romantic task of all, the reaching down in the sea for sunken treasure. Only last fall the *Peacock* figured in the beginning of what turned out to be one of the most successful treasure hunts attempted in American waters.

WITH nearly \$200,000 in gold and silver bullion and United States coin locked in her strong room, the *S. S. Colombia* left Mazatlan, Mexico, bound on the last leg of her regular voyage from New York to San Francisco. Wrecked in a gale during the early morning hours of September 13th, she settled on a reef off Point Tosca, buried almost to the base of her funnel in the swells.

When the salvage ship arrived, two days later, it was found that the strong room was submerged and in order to reach the gold the room would have to be blasted with dynamite or opened with torches.

For a week, seas and wind frustrated their plans. Then, in the face of an impending gale, and without again having chance to board the fast-breaking bulk, the salvors were compelled to return, empty-handed, to San Pedro.

After a hasty telephone conversation with the main offices in New York, it was decided that the *S. S. Homer*, once a ship carrying passengers to the (Continued on page 108)

HOW OFTEN have you wanted to know about the wonderful discoveries in science that have so changed the world we live in . . . the secret of radium . . . the romance of the atom . . . the origin of the earth?

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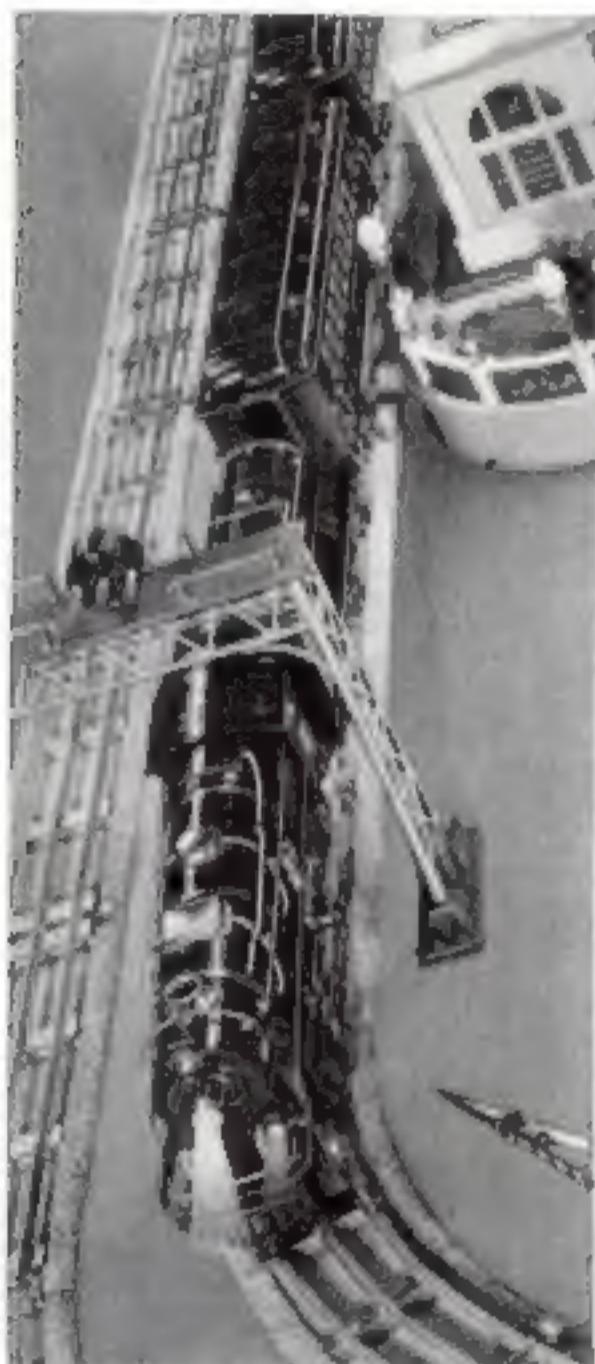
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Radio and Dynamite Find Earth's Riches

(Continued from page 42)

vibrations created by the motions of the operator in the truck containing photographic and other apparatus, and the vibrations of his small electric motor, it is placed in the ground 300 feet from the vehicle. As a matter of fact, the ear is so sensitive that it is impracticable to operate it at more than one-tenth of its full capacity.

The ear is brought into play mostly in the widely used so-called reflection method of locating oil wells. The other day, Rieber explained to me how this is worked.

Several dynamite charges are buried; those nearby in fairly shallow holes, and the more distant, heavier loads at such a depth that the initial explosions will deliver their force into the earth before blowing off the top.

WHEN, by closing a switch in the instrument truck, the dynamite, buried over a two-mile area, is set off, surface waves travel directly along the earth's upper layers to the ear. At the same instant, other waves shoot down, and are reflected back when they strike layers of hard rock below the surface of the earth. Oddly enough, the more distant explosions reach the receiver more quickly, in proportion to their distance, than the shots near by. This is because the lower, more solid beds permit the waves to travel faster, some of them up to a rate of 20,000 feet per second. By comparing the running time of the surface waves with that of the waves from lower beds, the depth and nature of those beds can be determined.

This ingenious method, developed by Dr. Ludger Mintrop, a German geophysicist, was introduced by him into the United States eight years ago. Mintrop, of course, did not have the benefit of Rieber's ear, and he employed portable seismographs in his work. His technique is adapted particularly to locating flat-lying layers of greater density than the surface layer. It has been used with sensational success in Texas and Louisiana, where the paths of vibrations through the earth often are broken by irregular underground formations.

Sound waves which go straight down into the earth, are employed wherever there are beds of sufficient density to reflect the waves. These shocks are timed much as a clocker times a race horse. As has been explained, experts, by calculating the speed of the waves through the earth, can ascertain not only the composition of the lower layers, but also the depth at which they lie.

After a recent survey, for example, Rieber reported that a body of unusually heavy and solid rock, probably volcanic, lay 2,000 feet below the surface of a California valley, and advised against drilling in that area. All oil-bearing rock is of the sedimentary kind. His theory that it was volcanic was based on the fact that the waves raced through it at a higher speed than is characteristic of sedimentary rocks.

Soft clays and shales transmit waves from 6,000 to 7,000 feet a second; hard shales from 8,000 to 10,000; soft limestone from 12,000 to 14,000 and basalt from 19,000 to 20,000.

His advice was not taken, and a well was drilled. It turned out to be a dry hole.

As a result of the new geophysical methods of prospecting for oil, about 25,000,000 people in the United States today can afford to buy

gasoline for their cars. In fact, so many new gushers have been discovered in recent years that the working time in several American oil fields has been curtailed to prevent over-production.

In Venezuela, Russia, the Argentine, Roumania, Persia, North Germany, the Dutch East Indies—everywhere, in fact, that oil may be found, prospectors with dynamite and marvelous instruments of precision are discovering new fields.

The tremendous importance of the new methods lies in the fact that, with their aid, treasure is unearthed in territories that bear no outward signs of mineral wealth. Most of the areas where surface indications could lead man to oil, already have been drilled. And this applies to other minerals as well. Cars, radios, airplanes, and other articles in daily use become cheaper as prospectors discover new sources of metal supply.

Prominent among the aids of the modern

prospector is the airplane. Today, up in Canada, exploring geologists search from the air for clues to stores of hidden wealth. In a single day of flying, geologists can explore an area they could not cover on foot in months. What can they see from the air? The Kennecott copper mine in Alaska, although not discovered from an airplane, is an answer to that question.

For years men prospecting for gold in Alaska had noted one green peak in a range of mountains, but had passed it by to pursue their hunt along the streams. One day, a bright prospector noticed that the green peak stood above the timber line. That green could not be vegetation, and he de-

termined to find out what it was. Climbing to the summit, he found the green was the familiar verdigris of oxidized copper. He had climbed a mountain of copper! It proved to be one of the richest deposits in the world.

Whenever a flying prospector sees an exposed rock surface that invites closer inspection, he marks the place on his map. Afterwards, detail parties make their way in canoes and afoot through the wilderness until they find that spot. Then, by trenching and the more modern methods, they make a systematic survey of the region.

Year by year, wonderful new instruments

are added to the prospector's tool-kit. Nevertheless,

the old-fashioned rule-of-thumb

methods still are used by geologists who are

sent into the wilderness to find buried treasure.

After all, the prospector is a kind of detective,

and some of his best work is still done by reasoning and deduction.

How simply an old mine was rediscovered

was told to me recently by Professor Charles P. Berkey, head

of the department of geology in

Columbia University, New York.

Dr. Berkey was a member of

the expedition that Dr. Roy Chapman Andrews led into the Gobi

desert for the American Museum

of Natural History.

In a Mongolian village, a woman showed Berkey a substance used as medicine. She had watched the geologists chipping rocks and assumed they would be interested in anything of the sort. The bit she gave Berkey was yellowish in color and the size of the end-joint of your finger. Many queer nostrums are used in China, but nothing that could have awakened keener interest in a geologist. Her piece of "medicine" was copper ore!

The woman said the piece of ore had been given her by a Buddhist priest, who lived in a lamasery, or monastery, some miles away. Several members of the party set out to find the priest and learn the source of the copper.

As they came in sight of the monastery, they saw several low hills. The color of those hills, bare of vegetation, told the geologists they did not need the priest's assistance. Driving directly to the hills they found—a mine.

It had been worked thousands of years ago, in the Bronze Age. The ancients who had extracted the ore from that deposit naturally had worked with the most primitive tools, but they worked thoroughly. All that remained were two yawning pits in the earth. One was more than 700 feet across, and each was so deep that its bottom was covered with water, and this, mind you, in the desert!

The emerald mines of Bogota we owe to the Incas of Peru. When Pizarro began the ruthless march that ended with the subjugation of those highly civilized Indians, his greed was aroused by the discovery of sacred images made of gold and jeweled with emeralds. The town where he first found those idols he called Esmeralda, but it was years and years before those jewel eyes of Indian gods were traced to the hills of Bogota.

Today, South American prospectors are searching feverishly to rediscover stores of riches described in history as the lost mines of the Indians. With the latest geophysical methods at their command, they stand a fair chance to succeed.



Wonderful Birds Are the Pelicans

This remarkable picture of the mammoth-billed birds, made by a British photographer, is an evidence of unconscious posing by the birds. So rare is the composition that studied effort by the photographer could have done little more. An article of interest to all who use a camera will be found on page 42 of this issue.

prospector, is the airplane. Today, up in Canada, exploring geologists search from the air for clues to stores of hidden wealth. In a single day of flying, geologists can explore an area they could not cover on foot in months. What can they see from the air? The Kennecott copper mine in Alaska, although not discovered from an airplane, is an answer to that question.

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